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EDITORIAL NOTES.

Public Authorities and Gas Legislation.

THE main line taken in last week's article in commencing the review of the gas legislation of the session was to utilize the lessons to show (supporting an article published a fortnight since) the need for a broader industrial policy, in order that, opportunely and appropriately, matters that assail common interests can be dealt with promptly and effectively. Precedents may affect those interests for good or ill; and it may be taken as generally true that, when county and local authorities oppose gas companies, it is not to invest the companies with some right, power, or restriction that will inure to the benefit of the concerns and the interests they serve. It is a singular thing that, although gas companies are *quasi*-public undertakings, many local authorities, when in opposition to them in Parliament, do not, or will not, see that the best way in which they can serve communal interests is to act co-operatively with, and not antagonistically to, the companies. The more restraint and burden they can impose upon them, the greater they appear to be pleased; and yet freedom, with the controlling effect of the sliding-scale and the competition that obtains everywhere to-day, and never more than to-day, is the road to serving the best interests of every community. Antagonism to gas interests has been increased, and a narrow view has been largely encouraged, since so many local authorities have been allowed by Parliament to trade in electricity supply. These municipal trade competitors come to Parliament without hindrance, and, are allowed to offer the fiercest opposition to the proposals of gas companies, at the same time requesting the fixing of fresh trammels and terminals on the latter. But let a gas company—possibly the largest ratepayer in a town—approach Parliament with the view to securing some control over municipal expenditure in speculative ways, the cry is at once raised that trade rivalry is the prompting force. The position however viewed is absurd; as is also the conflict of local interests (apart from purely commercial ones) that is engendered and fostered by erroneous notions and municipal trading. The interests of a gas company are the interests of the ratepayers that they serve; and any operation of the local authority that hits a gas company adversely hits, through the company, the consumers of gas who are also ratepayers. These are points that are deliberately pushed on one side by local authorities, and innocently lost sight of by some Parliamentary Committees—fortunately not by all.

Followers of our parliamentary records know how hard various gas companies have been pressed by county and other local authorities in recent sessions to accept clauses regarding the use of heavy steam-rollers, the laying of pipes at unnecessary depths in roads, and for bearing the burden of expense of altering the position of pipes when such change is demanded by the operations of the authority concerned, though parties to the original placing of the pipes. There seems to have been almost concerted action on the part of county councils in these matters, and some of the smaller local authorities have pursued the same course. If there has not been concerted action, then example has had a stimulating effect upon the authorities. Railway companies, too, have been increasing the rigidity of their so-called protecting clauses in connection with gas-distribution systems. Most gas companies (to their credit be it said) have offered strong resistance to the new and onerous impositions. We say to their credit, for the prevention of the creation of precedents of this kind is a matter that concerns the entire industry. Other gas companies have calmly accepted the clauses without resistance. Their acceptance is neither public-spirited, nor is it correct from the legislative standpoint. Sir Edwin Cornwall, during the session (in his office as Chairman of a Select Committee), stated the position in a few words when dealing with the Staffordshire Potteries Water Bill. His view is that promoters of Bills ought not to agree with public bodies or railway companies to insert clauses in Bills giving such bodies rights and powers in excess of what they are entitled to under the common law of the land. What did Sir Edwin mean by this? That the Legislature has already defined the limit of protection to which there is title; and anything in excess of this protection ought only to be conferred by Parliament. Agreement to the insertion of such excess rights and powers in a Bill is tantamount to trespassing upon the functions of the Legislature, as it amounts to an amendment of the general law in favour of a single body or concern. All Select Committees are not so jealous of the prerogatives of Parliament as were the honourable member referred to and his colleagues; but most of them when promoters offer some objection to being saddled with such excess powers are willing to recognize the sufficiency of the general law until it is deemed expedient by the parliamentary authorities to alter it. For instance, the South-Western Railway Company tried to get into the Woking Gas Bill special supervisory and other powers—powers such as we believe some other companies have accepted. The Woking Company resisted the proposed trespass on their existing rights and obligations, and succeeded.

The point was illustrated in another way in the case of the Wandsworth Gas Company's Bill, when the Surrey County Council asked that the Company should have imposed upon them the obligation of a 3 feet depth for their pipes. Lord Ribblesdale and his colleagues, without knowing anything of the technical difficulties involved, and not appreciating that foundation and not depth is the essential to pipe safety, enacted that a depth of 3 feet should in future apply to the Company all over their district, though the Surrey County Council have no jurisdiction in part of it. The Committee, however, subsequently modified their decision by stating that it was not to bind any local authority who were satisfied with a less depth. What does this amount to? It places in all cases throughout the area the final determination of depth up to 3 feet in the hands of the local authorities, and up to that depth excludes the right of option on the part of the Company, who are as anxious to safeguard their property as the local authorities are to get as much liberty and exemption from liability as possible at the cost of other people, and without consideration, too, for the interests of other users of the subsoil. But other Committees of the House of Lords have refused to follow Lord Ribblesdale and his colleagues in their decision. Lord Burnard in the York case, and the Marquis of Bristol in the Woking case, declined to accede to imposing a 3 feet depth on the Companies. Thus we have three Committees in this one session giving diverse decisions on this subject—one determining a 3 feet depth without any proper knowledge of the consequences or necessities, and the other two persuaded by the experience placed before them that such a prescription was unnecessary. There again is a matter of common interest to the industry.

In connection with the York, Wakefield, and Fleetwood Bills, there was some persistent opposition by the Local Authorities; but the character of the evidence of the opposition had the good effect of emphasizing the fact that the companies concerned were working for the mutual interests of public and undertakings. However, in the case of the York Bill, in the first House, there was a notable decision, which we then regarded, and still regard, as unjust, in the fixing of the standard price of gas at 2s. 3d., while the ordinary charge is as low as 2s. 2d. It appears from this that it does not do for a company to wait until they have got down to a low price before asking for the application of the sliding-scale, just as it is found, by parliamentary experience, to be a bad policy to allow the sliding-scale in respect of dividends to remain dormant. As sure as a company neglect to obtain sliding-scale powers, while serving the community well in the matter of price reductions, they will have to pay the penalty through the standard price when approaching Parliament for the application of the sliding-scale; and

when a company, possessing the sliding-scale, do not utilize it, in the matter of dividend, it is certain Parliament will say, "This shows you can afford to forfeit, without injury to "the shareholders, part of the standard price." These present themselves as strange proceedings; but they are real. However, in the York case, though the Corporation own the electricity undertaking, arrangements were made, while the Bill was passing between the Committee stages in the two Houses, for a transfer of the Gas Company's concern. The Fleetwood District Council wanted to get a purchase or suspensory clause in the local Gas Company's Bill. But the hollowness of the case the Council, with singular indiscretion and presumptuousness, put before the two Select Committees was visible to both; and their appearance at Westminster was waste of money both for the ratepayers and the gas consumers.

This question of the purchase of gas undertakings hinges on that of the finances of municipal trading departments. Twice this session it has been determined, as it was in the Milford Haven case last session, that the borrowing powers of municipal gas undertakings should have a definite limit put to them, to prevent the administrators of such concerns going to the Local Government Board *ad infinitum* for additional capital. The two cases were the Ashbourne Bill, and that of the Newcastle-under-Lyme Corporation. The object of capital restriction is to bring the statutory powers of municipal concerns periodically under the review of Parliament, the same as is the case with statutory companies. The intention is a very proper one. It should, however, be applied not only to municipal gas undertakings, but also to the other trading departments of local authorities. The Salford Provisional Order went through, with an agreed limitation of profit appropriation in aid of the rates. But in the new Gas Purchase Bills, Parliament has not, as it might have done, made provision straightway for the limitation of profit appropriation, or for the complete abandonment of the practice. This must, however, in time follow what is now being done. Municipal trading in electric wiring and fittings received a hard blow when the House of Lords declined to allow the Sheffield Corporation Electricity Department to continue to carry on this business, except through local contractors. In connection with the "Powers "to Supply Fittings" clause, the Ashbourne District Council Gas Department are given the power only on condition that the work is carried on through local contractors.

In the Bill of the York United Gaslight Company, a new line was taken in relation to the laying of pipes in private roads. The Corporation asked for supervisory rights, on the ground that (even though their gas-works purchase proposal did not succeed) the roads would ultimately come under their jurisdiction as the road authority, and therefore they ought to have the right of some voice in the decision as to the position of the pipes in the subsoil of such roads. The Bognor Gas Company are to-day the statutory electricity suppliers for the town through the powers obtained this session. Touching also electricity supply, the Cheltenham and Holmfirth Gas Companies met with a very unsympathetic Committee when they asked for the insertion of controlling powers in Orders promoted by their respective local authorities. Though excellent cases were made out for the Winchester clause, with, in the case of Cheltenham, an extension, the Committee appear to have viewed the Companies' request as emanating only from trade rivals, and not from large ratepayers who, while having to meet the competition of the authorities, have, through the rates, if not to help to liquidate loss, to pay heavily for the public electric lighting, and so contribute to the support of the electricity concerns.

In this review of the gas legislative work of the session, we have touched specially upon those matters that have supplied lessons showing the growth of a position that calls for the broader industrial policy that has been advocated, and which policy has for its object the fullest co-operation in the causes of industrial protection and advancement.

Economics of Administration.

In the concluding part of an address the title of which might well have been *Multum in Parvo*, the President of the North British Association of Gas Managers (Mr. Samuel Milne, of Aberdeen) last week spoke of the advantages of having what he terms a "cleaning-up day" upon a gas-works, which day of examination and cleaning enables the discovery of potential troubles, and consequently permits the remedy to be applied before otherwise the trouble would actually disclose the existence of its cause. After reading the broadly-laid address, and finishing with the "cleaning-up" process, we cannot help thinking it would be a good thing if those having charge of the management of gas undertakings would sit down periodically, and make deliberate examination of their administrative methods, to ascertain whether, in the light of accumulated experience, there are in those methods any scope for improvement—improvement which can be applied to the advantage of the whole undertaking. The President shows by his address that, at Aberdeen, with changing circumstances, the administration of the gas undertaking has adopted very liberal views on the subject of the economics of administration—a subject with which there are still some gas administrators who have but a very limited acquaintance, to the detriment of the gas undertakings they pretend to manage. The economics of administration are not wholly concentrated in cutting-down expenditure to the narrowest possible limits. It is good to be economical, and not extravagant; but the President brought before the members of the Association some apposite illustrations, from the Aberdeen experience, of how generous and well-directed expenditure oftentimes produce an excellent reward for the undertaking, as well as an extension of service to the community. Such management has as much right to inclusion in the category of administrative economics, as the spending of money to save expenditure, and as the suppression of wasteful and unfruitful expenditure.

The gas industry has, as the President points out, made marvellous progress during the last decade; and the progress is not the result of any one cause, but the result of interacting causes. It is through the general progress that there has arisen the ability to bring down gas charges to figures never before reached. But the President philosophically asks, What is the good of all this if new administrative ideas and methods are not to be applied to make the utmost use of the more favourable position? Cheapness of supply enables extended service, extended service creates business, new business tends to a reduction of the overall costs per unit of production. The President starts at the very beginning of the distribution system so as to see where the science of administrative economics can be brought to bear. There are the mains and meters. Neglect of these is responsible for much waste of the fruits of economies realized in other directions. He is confident that a more frequent examination and overhauling of meters would be highly beneficial in reducing the unaccounted-for gas, which item in Aberdeen is down to $3\frac{1}{2}$ per cent. In passing, surprise is expressed that several large and medium sized undertakings still continue to send their meters to the makers for repair, instead of having their own workshops for the purpose. There are some sound arguments on both sides for dissimilar practice. Geographical considerations in relation to the makers and transport costs are points; there is the question, too, of experience and facilities. But, on the whole, economy must be in very many cases on the side of directly undertaking the work of repair; and there is little question about it that a works' meter repair department does tend to a more frequent overhauling of the meters. With 42,500 meters in use, the President does not spend more than £675 per annum on their repair—at any rate, that is his average for the past five years. This is good work; and we opine that meter makers would have difficulty in persuading the President that he is, in this matter, the victim of some economic fallacy.

We come to the question of the economics of administration in relation to the consumer; and we are at once met by a statement in which is embodied a very live principle. "I know," said the President, "of no case where a liberal "expenditure in getting new consumers on easy terms has "not resulted in good business, and justified the expendi-"ture." This he also proves by reference to Aberdeen experience, where the policy of issuing free cooking appliances has in the current summer months resulted in an increase in the consumption of gas by 17 per cent. The figures that he advances are really remarkable, and worth the attention of all gas administrators who are considering what steps they shall take in adopting a more forward policy. The real meaning of the words just quoted from the mouth of the President is that there is the economy of a rich result to be derived from a generous administration of the gas sales department. There is an unqualified agreement with him; but at the same time the character of a district must have some influence in the determination of policy. Within

knowledge, there are districts where, for example, the percentage of gas consumers with cookers on hire is high, and perhaps higher than Aberdeen can boast with free cooking appliances; but the residential characteristics of those districts are altogether different from those of the Granite City. The policy of free cookers or of cookers on hire must depend upon local circumstances.

Touching the broad question of deriving economy from business expansion, it is one as to the choice of supporting the British Commercial Gas Association in the general promulgation of information concerning gas utilization, and in defending the industry against unwarranted attacks upon the part of commercial rivals, or of spending the money on local exhibitions and in other advertising ways. Our own view is that support should be divided. There is no doubt that good live working exhibitions are required. The day of the old inanimate exhibition has passed. Such exhibitions are useless, and the objects of the derision of our commercial rivals. But however live such exhibitions are, they cannot possibly serve all that the gas industry needs. There is something beyond that has to be done; and it is in that "beyond" that the British Commercial Gas Association moves and has its being. Really only a small proportion of the residents in a gas-supply district goes to the local exhibition. The class of people whose custom is found most pregnable by our trading competitors are those who will rarely set foot inside a local trade exhibition; their interest is not stirred sufficiently to induce them to accept the invitation to pay a visit. There is likewise the class at the opposite end of the social scale who harbour the idea that their room at such affairs is preferred to their company. Only by a general campaign are such people kept properly informed. We have to reach by the means that are most effective those people who have influence; we have to meet the operating means of those who would take from us those things that are our possessions in the present time. We are not to-day where we were in this matter; and that is what gas committees and gas companies have to learn. Having learnt it, they will readily see that local enterprise cannot unaided cover the entire field.

However, so we might go on taking point by point for comment from this address illuminating the subject of administrative economics, and throwing light on various topics—even to a troublesome naphthalene experience, the real cause of which we think the President has discovered. But the issue of the consideration of all these subjects is that, despite increasing burdens, the gas industry has, as we were recently saying, proved its remarkable power of adjustment, and a vitality that promises, along such wise administrative paths as those traced in the address before us, to build greater and greater prosperity upon the broad foundations of the present.

The meeting of the Association at Aberdeen last week had before it a full-bodied programme of much technical interest. There was the first William Young Memorial Lecture by Dr. Harold G. Colman, upon which comment is made in the succeeding article. There were also four papers treating of a variety of topics to which we will give consideration in our editorial columns next week.

Travel of Gas through Retort Charges.

WERE it not that in the progress of things the gas industry cannot, and must not, stand still technically, we might be inclined to be a little ungrateful to some of our learned doctors and professors for keeping us in a state of unrest concerning the scientific problems that encompass certain work in the industry. As it is, there must be some gratitude, and especially when fresh discussion gives a more substantial and comfortable seating to the truth of the solution of problems than was previously the case. In the evolution of things, all competent examination of problems that are not clearly solved contributes to advance. The first "William Young Memorial Lecture," delivered by Dr. Harold G. Colman at the meeting last week of the North British Gas Managers' Association, suggests these remarks. These lectures are not intended to be a panegyric of the man who is so highly revered for his work. But just as William Young exercised the great gifts with which he was endowed in dragging (as Dr. Beilby puts it in an "Appreci-" ation" written for the occasion) from "the dim background "of the immediate problems of industry" those matters the truth of which we desire to know in order to make the truth the path of progress, so these lectures will best serve their end by causing them, in one way or another, to extend our knowledge of those subjects upon which Mr. Young himself threw so much light. One of these subjects is carbonization, upon which, right close to the end of his life, he exercised his vast intellect by bringing together in our pages considerations affecting those sides of the question that modern changes had brought into touch with current requirement. It was carbonization that Dr. Colman took for his topic, about which complex subject we have still, as he says, a great deal to both learn and unlearn.

The lecture is of a controversial character in its main part, which main part succeeds the examination of the effects on the derivatives of coal carbonization of the use of respectively high and low temperatures in the process. We need not, however, touch on this prefatory, though necessary, portion of the lecture—necessary in that it is only through the knowledge of what it contains that there can be an intimate appreciation of the reasoning that is advanced in the controversial, or second, part of the lecture. In this part, Dr. Colman discusses and rejects the theory of Dr. Bueb, Mr. Young, Professor Lewes, and others (and which theory was Dr. Colman's own preconceived belief) that the travel of gas and vapours through the charges of coal in retorts—the heavily charged horizontal and vertical retorts —was mainly through a central core, and therefore through the coolest portion of the charge. He has thrown down the glove to those who have promulgated and who have accepted the theory on the ground that nothing could be more natural than that the gas as evolved should take the path of least resistance. In effect, he points out that, while the lower temperature core may be the path of least resistance for the gas that is evolved on the inner side of the pasty wall of caking coal that is constantly forming and changing place nearer and nearer to the axial line of the retort, the pasty mass itself is a strong resisting barrier to the passage to the central core of the gas formed on the outer side of the pasty wall, and which is the gas of greatest volume. Dr. Colman bases his assertion and his change of view on chemical investigation; but he himself confesses that his investigations have not proceeded so far that his position is as strong as he would like it to be, though he has sufficient confidence in the truth of his altered view to make it public, and to challenge the theory of those who entertain the contrary view.

It really does not matter much which hypothesis proves to be the correct one; and it is one of those questions (however strong one has been as an adherent to one belief) over which one can shift easily to another when it has been proved beyond a doubt that the original belief is no longer tenable. But although it does not matter very much which hypothesis is correct so long as the results desired in regard to gaseous and liquid products are obtained, a knowledge of the truth of the matter may form some guide to further advances in carbonizing results. Therefore, we could wish that Dr. Colman could have spoken a little more definitely in the evidence he adduces as to the grounds upon which he has changed over from the central core travel theory to the incandescent coke travel theory. Where Dr. Colman is strongest is as to the source of the greatest evolution of gas being on the external side of the pasty wall in the carbonized charge; and therefore, on *a priori* consideration, it seems to be the natural thing for the gas to take its path through the fissured and contracted part of the charge already carbonized. Chemical examination of the gas and tars both from horizontal and from vertical retorts indicates that they have been subjected to the high temperature of the coke, and not to the lower temperature of the central core. What this chemical examination exactly reveals is set out in the lecture; but the story is too long to relate here. The characteristics of both the gas and tar, Dr. Colman submits, are altogether opposed to the theory as to the travel through the low temperature core. There is the pressure, too, of the gas in the inner core—instead of it increasing as the uncarbonized core diminishes in area, it is reduced. This, again, is contrary to what Dr. Colman would expect to find if the gas passed away *viâ* the central core.

But, on the other hand, where Dr. Colman is not strong is in the omission of explanation as to the causes of the reduced quantity of naphthalene and sulphur compounds in the gas, and "free carbon" in the tar. Nor is there complete satisfaction that the positions from which he took his samples of gas from continuous vertical retorts conclusively prove anything. He tells us that in the continuous retort the point of the cone of uncarbonized coal is some two-thirds of the way down in the retorts. But he took one

sample from the centre of the upper charge, and only 7 feet from the top, and he found the great bulk of the gas here consisted of steam. On the other hand, a sample taken 4 inches from the side of the retort and 10 ft. 6 in. from the top showed the proportion of permanent gas to steam was about 100 to 30 volumes. In the central position, and only 7 feet from the top of a continuous vertical retort, it can be well imagined that steam would predominate. It can well be imagined, too, that the gas does not wait until it gets precisely in the centre of the core before taking an upward course; and it can further be imagined, if the resistibility of the pasty wall to the gas passage is such as is advanced by Dr. Colman, that the lower part of the conical pasty wall would be the part that is most intact and impenetrable. In continuously working retorts, too, we cannot think that with the ever-shifting charge, the conical pasty wall remains intact. As a matter of fact, when the conditions in a continuously worked vertical retort are considered, it supplies one of the strongest arguments possible against Dr. Colman's theory. Somewhere in that form of retort the gas and tarry vapours have to pass through the pasty wall; for the ever-succeeding charges of raw coal do not leave a constant and continuous outer circle of incandescent coke right to the top of the retort. If there were an outer casing of incandescent coke, it would not be impracticable, though perhaps a little difficult, to ascertain the volume of the flow of gas from either side of the pasty wall. This brings us to the point that Dr. Colman has not been able to support the deductions from the premisses he has laid down on this subject by any tests as to the relative volumes of gas travelling inside and outside the pasty wall. Furthermore, we fancy that, under continuous working, if the pasty mass were impermeable to the greater volume of gas and vapours evolved on its outside face, there ought to be a curious distribution of pressure in such retorts.

All things considered, strong as is the case Dr. Colman presents, we are inclined to think it will not close the controversy on this subject either from the deductive or chemical standpoint. However, his discussion of the subject leads him to point to at least two directions in which it is possible to still further improve upon the results obtainable with vertical retorts; and these will be found in the penultimate paragraph of the lecture. Dr. Colman cannot say how the improvements are to be practically secured; but he sees greater promise for the achievements in the continuous form of vertical retort than in any other form. There the matter stands. Dr. Colman may be entirely right; but there is the feeling that the proofs that he is right are not yet all on the table. However, he has contributed to the subject many new thoughts and views which will go far towards helping to bring the truth within our reach and grasp.

Road Crusts and Tar.

The gas industry has always had an intimate interest in road crusts and paving; for upon the character of these relies, in certain measure, the expense of pipe laying, repairing, and alterations, and, to an extent, the safety of its subterranean property. But since tar-surfacing became the vogue, the gas industry has had a twofold interest; and it has witnessed with gratification the triumph of one of its commodities for the purpose of primarily abating a nuisance, and secondarily of assisting in the preservation of road surfaces, and thus reducing watering and maintenance costs. The second annual report of the Road Board, however, brings us face to face with a new condition. The Board have come to the conclusion that the class of modern traffic which has brought about the necessity for road-surfacing is likely to further increase, and that perhaps what suffices in the present will not suffice in the future. This being so, the Board are persuaded that, unless there is a radical change from the present methods of constructing road crusts in many parts of the country, the costs of road maintenance will considerably increase, with the inevitable result that outlay in this direction will in the aggregate exceed the cost of at once taking in hand the provision of proper road crusts. Some local unstable materials that are largely used for the simple reason that they are the most available ones are condemned, as they result in road crusts below the proper standard of strength and efficiency. The Board, in short, have adopted a policy of road crust improvement, and are going to allocate funds for the purpose.

How is this policy of improved road crust construction going to affect the gas industry? We are of opinion that it will have an excellent effect. The Board advise the use of proper materials with a bituminous binder; and it is easy to see that this will have a good influence on the demand for one of the products of the gas industry. It is also evident that the Board have no idea of encouraging improved road crusts in order to eliminate tar-surfacing. This is apparent from the expression of the opinion of the Board that it will be greatly to the advantage of Highway Authorities, and will also enhance the benefit to be derived from the existence of the Road Improvement Fund, if Highway Authorities will undertake, with the assistance of loans, a larger amount of recoating work than they are able to accomplish immediately out of the rates. The Board are prepared, so far as funds permit, to advance loans (in most cases without interest) for the extra cost of road crust improvements which are likely to increase the life of surface coatings in a greater ratio than the increase of cost. This is satisfactory. We are afraid that the difference in experience with tar-surfacing has been due largely to the inability of some road crusts to contribute to the preservation of the coatings, as the coatings will contribute to the preservation of those road crusts that give to them a proper foundation. There is a mutuality in protection between proper road crusts and tar-surfacing; and the more there is of this mutuality, the better for the gas industry's new and enlarging market for tar and pitch.

Perturbed Labour.

Although the Labour Congress at Newport, Mon., last week had as its Chairman one of the arch-socialists in the Parliamentary Labour Party—Mr. Will Thorne, the Secretary of the Gas Workers' and General Labourers' Union—there was somewhat less of the frenzied style of speech and the simulated confidence that have characterized some of the congresses in recent years. It is open to the onlooker to think that recent events in the Labour world have shown some extremists in labour politics that they cannot rule the country in their own rough fashion, but that there are other forces as formidable as their own that must be encountered, and have to be consulted. It is also quite obvious that the violent methods of prosecuting claims that have been devised by the extremists have not been to the taste of a not unimportant section of the rank and file of trade unionists; and there were, from more than one part of the congress room at various stages of the proceedings, warning words that convey the impression that the opinion is not now unanimous that the trade unions acted wisely in linking themselves up with socialism in the way they did but a few years since. The new order of leaders moves too quickly to be palatable with their excessive demands and equally excessive plans of campaign; and there is no question that certain of the thinking leaders can see in these things an ultimate self-destruction of the trade unions and their legitimate objects.

This was especially seen in the discussion that was raised on the Trades Union (No. 2) Bill. Labour members of Parliament now enjoy, in common with all other of our legislators, a salary of £400 a year; but they are not satisfied with this. They still hanker after a reversal of the Osborne judgment, so that they can make a compulsory levy for political purposes, whether or not all members of the trade unions are in favour of the policy adopted. The resolution that the conference discussed protested against any interference with the elementary principle of self-government, claimed full liberty of political action, and instructed the Parliamentary Committee to get the Bill in question amended so as to restore completely political freedom (illegally) "enjoyed" by trade unions prior to the Osborne judgment. Liberty is an impressive word; and, while the resolution makes much use of it, its whole intention is to remove the liberty of political support from the individual, just as the same extremists would remove from the non-unionist the liberty of exercising his labour as, when, and where he likes. The payment of members of Parliament has over-ridden the necessity for the reversal of the Osborne judgment; and therefore the passing of the resolution makes it abundantly clear that the trade union extremists want the extra funds for some purpose other than the maintenance of members of the Labour Party in Parliament. However, it was in this discussion that both Mr. John Ward, M.P., and Mr. Havelock Wilson counselled greater moderation. The former warned the congress that the delegates must not mistake their own opinions for those of the country generally. Mr. Havelock

Wilson spoke deliberately against a reversal of the Osborne judgment, and he also warned those who were pushing to a head this matter of a compulsory levy for political purposes that they had not the rank and file of the unions with them. There were other indications of the feeling that things are not trending altogether as they should do in the best interests of the trade unions; and it is pretty certain that the delegates to this conference do not represent the opinions of a vast proportion of the labour of the country to-day. They are out of touch with those opinions, and well they know it.

There was much of the ancient order of things composing the proceedings at the congress. The old requests, and the old commonplace arguments. The only interest that can be found in them is due to the necessity for all industries employing labour to keep close watch upon current influences, plans, and any extensions of labour doctrines, besides observing closely the movements in labour in other industries that may be detrimental to their own. In the gas industry, we are well guarded by co partnership, by good wages, and by the general protection of the employees by employers. But it is not the same in all other industries. Hence, disturbance and strikes. Hence, too, the leaning of the present Government towards compulsory arbitration. But if the Government pay any heed to the doings at these congresses, they will see that the delegates, by an enormous majority, declared their bitter enmity against anything in the nature of compulsory arbitration; and they have refused *in toto* to allow their Parliamentary Committee to even go to the trouble of inquiring and reporting upon the subject. If the vote on this matter has really in respect of labour opinion the substantial significance of the trade union membership figures that the voting represented, then the Government will, if they pursue this matter, bring upon themselves still further troublous times, for trade unionism (through the delegates) shows an uncompromising front to yielding up the strike in favour of compulsory arbitration. This was really the most important matter upon which the congress were called upon to vote at Newport last week.

Valuation Statistics.

There are some big figures to be found in Part I. of the Annual Local Taxation Returns for the year 1910-11, which has just been issued, and which shows that during this period the total gross estimated rental for England and Wales (including the "gross value" of rateable hereditaments in London) rose from £269,942,255 to £272,249,125, this representing a net increase of 0·9 per cent. At the same time, the rateable value increased from £217,180,184 to £218,588,250, or to the extent of 0·6 per cent. The increase in London in the gross value amounted to 0·06 per cent.; but this was accompanied by a decrease of 0·3 per cent. in the rateable value. For some ten years previous to 1908 the rateable value of agricultural land in England and Wales persistently decreased; but since then there has been a steady increase—the gain on the present occasion being nearly £61,000 over the previous year. Between 1907 and 1911, the increase in England and Wales in the gross value (or gross estimated rental) of property amounted to nearly £13,500,000, and the increase in rateable value to almost £8,800,000, of which £7,200,000 represents the increase in urban areas and £1,600,000 that in rural areas. In this calculation, no allowance is made for alteration of areas. The gross value of property in London increased during the same period by nearly £1,000,000, and the rateable value showed a net increase of almost £600,000. The percentage of increase in the gross value (or gross estimated rental) for the period mentioned for England and Wales was 5·2, and in the case of the rateable value it was 4·2. In London, the corresponding figures were respectively 1·8 and 1·3. Comparing the valuation in 1911 with that which was in force in 1897, it is pointed out in the Blue-Book that the rateable value of agricultural land diminished during the eleven years from 1897 to 1908 to the extent of 2·8 per cent.; but the increase in value in the three following years has reduced the net decrease in this class of property to 2·3 per cent. In the case of other hereditaments (excluding the annual value upon which Government contributions were made), the rateable value increased between 1897 and 1911 to the extent of 34·8 per cent. The total rateable value of rateable hereditaments in England and Wales (exclusive of the annual value upon which contributions in lieu of rates were made by the Government) increased by 29·4 per cent. during this period.

PERSONAL.

Mr. C. E. Teasdale, Assistant Constructional Engineer in the Gas Department of the Salford Corporation, has been promoted to the position of Assistant Superintendent of the Regent Road, Liverpool Street, and Albion Street Gas-Works. Mr. F. H. Goodwin, the Chief Draughtsman, succeeds Mr. Teasdale as Assistant Constructional Engineer.

Mr. Edward Whiteside, of Blackpool, has been appointed Solicitor to the Fylde Water Board, in succession to Mr. T. Loftus, resigned. There were four candidates selected to appear before the Board last Thursday week; and it was only by the casting vote of the Chairman (Alderman J. Bickerstaffe), given after three equal ballots, that Mr. Whiteside was appointed.

At St. Mary's Church, Bearwood, Birmingham, on the 2nd inst., Mr. R. J. Rogers, the President of the Midland Junior Gas Association, was married to Miss Emily Minnie Carter, elder daughter of Mr. and Mrs. Thomas Carter, of Smethwick. The bridegroom was attended by Mr. F. A. West, of the Peterborough Gas Company, as best man. Among the many valuable and appropriate gifts received was a handsome clock presented by the Superintendent and staff of the Fittings Department of the Birmingham Corporation gas undertaking, in which Mr. Rogers holds the position of Chief Commercial Representative.

OBITUARY.

HENRY JOHN DAVIS.

One of the best-known men connected with the gas-stove industry has been removed by the regretted death, last Thursday afternoon, in his 71st year, of Mr. Henry John Davis, the Chairman of the Davis Gas-Stove Company, Limited, of London and Luton. While motoring from Eastbourne to Tunbridge Wells, Mr. Davis felt slightly indisposed, but the trouble seemed to pass away. On arriving at the latter place, however, he expressed a desire to return to London by train, rather than in the car, and with this end in view proceeded to the railway station. His intention in this respect was not destined to be fulfilled, for on reaching the station he had a seizure and lost consciousness. Recovering from this attack, he again expressed a wish to get back to London; but a doctor, who had meanwhile been summoned, insisted upon the patient's removal to his hotel in Tunbridge Wells, and there he shortly afterwards expired—the cause of death being heart failure. Thus he died, as he had lived, in harness; and his many friends will have the consolation of reflecting that his end was a peaceful one.

To say Mr. Davis's "many friends," is not merely a figure of speech; for his great geniality and extreme evenness of temper made him a universal favourite. This applies equally to those who were his trade rivals as to others; and among them there is common consent that their old friend was never guilty of playing any one of them a shabby trick in order to secure an advantage among their customers. Commercially he was as successful as he was socially. It was in about the year 1877 that he started in the smallest possible way to make gas-stoves, his determination to embark in this branch of industry being based upon his firm belief in the great potentialities of the gas-stove trade. This unbounded confidence never left him; and he lived to see his most sanguine anticipations realized. Commencing with a staff of two men and a boy, a process of continual development has been passed through, until at the present time the business has grown, in all its ramifications, to such a size that £1000 a week will not cover the wages of the employees. Of unflagging energy, Mr. Davis's interest in the business never slackened, and he was quick to note anything calculated to improve it. He had occupied the position of Chairman ever since the constitution of the undertaking as a limited liability company; and there have, of course, been associated with him his two sons (Mr. Harold N. Davis and Mr. Cyril G. Davis), to whom much of the credit is due for the enormous development of the business. It may be mentioned that Mr. Davis had a seat at the Board of Meters Limited. He was also a Freemason, and was initiated in the Evening Star Lodge (No. 1719) in the year 1882, and occupied the chair in 1897. Among the floral emblems of regard that will accompany the deceased to his last resting place is one from the Lodge. Having regard to the deceased's personal dislike to any form of ostentation, it was felt that it would be most in keeping with his wishes if the funeral (which will take place to-day at Tunbridge Wells) were of a strictly private character.

It was announced in the "Journal" last week that Dr. G. T. Beilby, F.R.S., had been appointed a member of the Royal Commission on Oil Fuel, in succession to Mr. H. Owen Jones, who recently lost his life while climbing in Switzerland. It may be mentioned that Dr. Beilby, who was for a long time associated with the late Mr. William Young, and whose appreciation of him, read at the meeting of the North British Association of Gas Managers, appears elsewhere, has been President of the Society of Chemical Industry, of the Institute of Chemistry, and of the Chemical Section of the British Association, and is now Chairman of the Glasgow and West of Scotland Technical College.

INSURANCE ACT AND GAS WORKERS.

Additional Decisions by the Umpire.

Since the last reference to the subject of the position of gas workers under the Insurance Act [see *ante*, p. 557], some further decisions have been given by the Umpire. He has decided that contributions are not payable in respect of workmen engaged wholly or mainly in running gas-engines and producer plant, and charging the latter with fuel in connection with the manufacture and compression of oxygen or acetylene; in making instruments for testing gas; and as brass finishers grinding-in gas-cocks for incandescent lamps, in making patterns for gas-fittings for use therewith, and in putting gas-fittings into casings for lamps, and making gas-fittings. Contributions are, however, to be payable in respect of workmen employed by a firm of mining tool manufacturers, and engaged wholly or mainly as engine-tenters and in working gas-producing plant; also by workmen engaged wholly or mainly in fixing boiling water apparatus and coffee-making machines in restaurants and buildings generally, and in keeping in repair the gas and water fittings after they are fixed.

ELECTRICITY SUPPLY MEMORANDA.

Cooking and Heat Storage—"Lightning" Cookers—More "Meat-" Saving Records—Stout Resistance by Joints to Perspiratory Inducement—Some Municipal Electrical Trading Experiences—Surpluses Absent or Small—Coal Costs.

From Australia come two pertinent questions. They are sent by Mr. P. J. Pringle, of the Electric Supply Company of Victoria, and are published in the "Electrical Times." He is doubtful as to whether the electrical industry is proceeding on sound financial lines in the matter of tariffs and forms of heating appliances. He points out that for cooking in his own household he uses 6 or 7 units on the average per day, with a maximum demand of 2½ kilowatts. In the average town, he finds that this maximum demand superimposes itself on the lighting peak, or comes very near to it. The first question he asks is, under the circumstances, how can the sale of these heating units at such low prices as 1d. or ½d. per unit be justified? It is a question we have asked before; and Mr. Pringle is the first central station engineer who has so frankly said that, if the problem is seriously considered, justification cannot be advanced. The "Electrical Times" does not venture to reply to the question. Mr. Seabrook does—in his usual light and airy way. But Marylebone is not Australia; and in Marylebone, so Mr. Seabrook says, the overlapping of the lighting load by the cooking load is negligible. Believing that electric cooking, as required in the average household, will not give a higher load factor than private lighting, Mr. Pringle puts the second question, Why, therefore, should the latter be charged four to five times the price? Exercising his brains as he will, Mr. Pringle cannot find a rational excuse for the charges. He can, however, see that, if business in electric cooking and heating develops, it will demand an entire reconstruction of the mains, and the provision of special generating plant to deal with it. Then who is to pay for this, the consumer for lighting or the consumer for cooking? His suggestion is that cooking and heating appliances must be designed to reduce the maximum demand to the minimum point; but he regards as still more important the provision of heat or electrical storage, so that the energy for cooking and heating may drain into the consumer's establishment the day through. Heat storage for cooking as well as for water heating has been heard of before. There is the "Therol" water-heater, and the Bastian as well as other heat storage proposals for cooking. But what of the success? "Ifs" actively project themselves into the reasoning on the subject. "Meteor," for instance, is fairly overpowered by them. In his ruminations, he says: "*If* it is wholly successful, on a commercial scale, *if* it yields us roasting temperatures, *if* it be free from the danger of excessive superheat and other troubles due to neglect of the consumer to abstract heat, then we quite join with Mr. Pringle in foreseeing a great future for such a storage system. Otherwise the mains question and the maximum demand are certainly going to be a difficulty in most districts, despite optimism based upon special neighbourhoods." So say all of us.

Many electricians are dabbling in the invention of electrical cooking appliances, with more or less success—generally less. Mr. Napier Prentice, of Felixstowe, Diss, Stowmarket, and possibly some other places upon which the eyes of the world are not perpetually set, has, as noted on a former occasion in the "Memoranda," invented what he calls the "Lightning" cooker, and which, among electrical appliances, according to report, holds the world's record for resisting the propensity of meat to shrink. Talk of the "Marylebone," "Tricity," and other ovens that have obtained notoriety in various ways, they do not live in the same street, in respect of this one and apparently only merit, as the cooker invented by the Prentice hand. It is a wonderful looking cooker; but what premium would be required by a life insurance company if it were insured, we dare not say. It is a cylindrical cooker of bright polished metal; and the pictures of it suggest that it is of such diminutive size that a joint of goodly dimensions has not the opportunity either to swell or shrink, as the steam from the meat would, it may be imagined, soon rise in the restricted space to such a pressure that it would absolutely decline to allow anything more than a limited exudation. As to the construction of the cooker, first there is the heating element, which is wound round the periphery of a cylindrical frame, and is connected with three switches, for varying degrees of heat. The heating element is enclosed in the polished metal cylinder, which is called the "diving-bell." A tray frame, like a cake or fruit stand, is provided; and on this the food is placed. Then, reminding one of a conjuring hat trick, the cylindrical casing with the heating element inside is placed over the viands to be cooked. It does not appear as though, however much the inquisitive cook wants to see how things are going on, he or she can do so without lifting the cylindrical extinguisher entirely off. We should fancy the heating element, being placed in such proximity to the meat, is likely to get well coated with grease. It is not gathered that a ventilating opening is provided in the cylindrical tin-can arrangement; but, if not, what about those poisonous fumes that an expert electric cook was a short time since telling us emanate from meat while being cooked? It would also be of interest to know whether, if this is a steam-charged chamber, the meat is cooked by being baked or by being steamed. While answering these inquiries, Mr. Prentice might tell us whether his cooker provides for boiling, stewing, frying, and so forth, which constitute such a large proportion of the culinary work of a house.

Mr. Prentice has had some cooking tests made at the Grand Hotel, Felixstowe, on massive joints. For example, weighing meat and gravy together after cooking, a 19 lb. 13¾ oz. joint of topside of beef is stated to have lost only 11¼ oz., or 3·5 per cent.; while another joint of the same description, but weighing 20 lb. 4 oz., only acknowledges a departure from its original weight (giving it credit for the weight of the gravy) of 8½ oz. It was extremely wrong of the joint that started with a weight 6¼ oz. less than the other one to shed 2¾ oz. more during cooking. We wonder whether these joints were well done to the centre, and browned as a baked joint ought to be. In another test—a 14 lb. 11½ oz. joint—the net loss, it is stated, was 3 per cent.; and the loss excluding gravy 5·9 per cent. This last test was quoted in the "Electrical Times;" and the writer of the paragraph in which it appears says that he has "the authority of one of the most respected gas-cooker firms," for saying that the loss of meat baked in a gas-oven is 40 per cent. Will our friends kindly supply the name of that "respected" gas-cooker firm, because if they own up to this being the result of proper cooking in a gas-oven, then it will be our pleasure to do a little towards tarnishing the respect. In a gas-oven, the cook can do almost anything she or he likes. She or he can bake a joint, and bring it forth again, in such a way that its measurement and weight are little less than when it went into the oven. She or he can obtain any degree of cooking required between that state and the cinder state. The 40 per cent. loss takes one a long way on the road that leads to complete destruction; and the cook who loses 40 per cent. of a joint in this manner earns the right to a speedy departure with a certificate for incompetence. Our electrical friends would carry more weight if they did not show so much eccentricity in connection with this matter, and if they mixed their statements and arguments with a little more common sense.

The managements of those municipal electrical undertakings that compel the financial support of the ratepayers do not appear to be very eager to have any presentment of their financial worries in the electrical papers; and therefore, for the last two or three months, our electrical contemporaries have been giving their readers the salient points from the accounts of certain of the more flourishing, and therefore to them financially pleasing, concerns. Some of these undertakings seem now to have "turned the corner" (they are often turning corners, sometimes forward, sometimes backward, in the electricity industry) in respect of the loss of lighting revenue through the metallic filament lamp—that is to say, the losses have discontinued, and there is a creeping back now over the lost ground. Leeds particularly shows this by the aid of its large figures. In 1907-8, the income from private lighting was £80,904; by 1910-11, it had fallen down to £62,241; in the past year, it got back to £66,450. Many undertakings of less magnitude, however, do not so clearly show this. Generally speaking, the increases in consumption during the past year have been mainly due to power. Take, as examples, Bristol and Coventry. At Bristol, the increase in consumption was about 1½ million units; but almost the whole of this advance has been due to power and heating, or on the combined rate for lighting and power. It is a pity electricity undertakings do not separate the energy consumed for power from that used for heating; the accounts would be much more interesting and instructive. Coventry had an increase in consumption of 2,529,402 units, and of this increase power alone accounted for 2,470,163 units. Comparatively little progress is made in other directions; and in many places there would be less made in this power branch if it were not bounty-fed by the lighting revenue. In places where a street-lighting policy is being pursued, the consumption position is interesting. Illustrations of a diverse character are Marylebone and Hastings. In Marylebone, the increase in consumption last year was 1,151,742 units—the total sale being 13,488,698 units, and of this 1,617,038 units were for street lighting. During the year, owing to protests as to bad lighting by the metallic filament electric-lamps, the Committee deemed it prudent to fix, in several thoroughfares, lamps of larger size, and to say nothing about charging any additional price for them. At Hastings, the consumption of the public lamps is nearly half as much as the total

private consumption—the street-lamps, according to the last accounts, taking 281,323 units, and private consumers 658,620 units. The people of Hastings question whether the metallic filament lamps so far as adopted are doing as well as the former incandescent gas-lamps, which were not of the most modern types for street-lighting; and complaints are heard of the erratic and irregular behaviour of the arc lamps on the front. Talking of consumption, it is remarked that Hammersmith last year found the rate of increase substantially less than during the previous year. Glancing at Wakefield, it is seen that, owing to an increase in the price per unit in 1910-11, there has been a reduction in consumption to such an extent as almost to neutralize the gain arising from the addition to the price. Under such circumstances, the Committee have urged the Council to retrace their misguided steps to the 4d. rate. This indicates how sensitive electricity consumers are to heavier accounts.

As already observed, only a minor part of the accounts of the municipal undertakings has been published in the electrical papers. Some of the concerns—those fortunates in good districts for private business—show excellent net balances; but electricity undertakings are like many plants, the degree to which they thrive depends upon the character of the soil in which they are rooted. A few of those whose accounts have been published have not made any surplus. For instance, Barnstaple has a deficit of £548; Bath, of £1522; Dudley, of £2108 (£1207 the previous year); Hereford, with £303 assistance from the borough fund, still exhibits £114 deficiency, making £486 with the amount short the previous year. Kingston-on-Thames is still on the wrong side to the small extent of £60; Kirkcaldy, by £226; and Paisley, by £142. There is a point of interest about the Hereford undertaking, the deficiency of which was just noticed. The electricity journals have exulted over the great benefit that the coal strike brought to electricity supply undertakings in the way of new connections. It may have done so; but there are few outward and visible signs of this. In the case of Hereford, it is definitely stated that, while there was an increase in business the first nine months of the year, amounting to 51,995 units, there was an actual decrease of 5227 units in the three months which included the coal strike. In the case of some other undertakings, the net profits—the so-called "net" profits, for many of the concerns have not put anything to reserve or depreciation—have been of the lean kind. Bermondsey boasts of only £627; Bexhill, £360; Darwen, £572 (out of the department's accumulated net profit balance £1000 is being transferred in aid of the general district fund); Eastbourne, £1089 (against £2213); Finchley, £491; Gloucester, £404; Great Yarmouth, £391 (the conversion of the street lighting is being charged against revenue); Hastings, £80 (total deficiency to date, and made good out of the ratepayers' private purses, £17,111); Leigh, £507; Newcastle-under-Lyme, £535; Oldham, £665 (compared with £1301); Shrewsbury, £82; Stirling, £526; Winchester after the first fifteen months' working as a municipal concern, £136 (the period, however, bore some extraordinary expenditure in connection with the transfer); and Worcester, £676. The surplus at Rochdale dropped to £2609; being a decline of £2800 from the surplus of 1910-11.

In view of the coal strike, the position in regard to coal is interesting. Some of the concerns came off well; others suffered; many experienced an extra cost per unit of electricity; while many more still will feel the effect of an increased expense in this connection during the current year. Several electricity committees are anticipating that, if business does not increase luxuriantly, the modest surpluses shown for the past year will be turned into deficits in the present one. Among the examples of increased cost for coal during the past year is Bristol, with £1621; Lancaster, £505; Marylebone, £1000; Norwich, £400; West Ham, £2500. Some of the accounts show the effect per unit of electricity generated. For instance, the cost of coal per unit generated at Eastbourne was 0·89d., compared with 0·80d. in the preceding year; at Grimsby, 0·291d., against 0·244d.; at Hull, 0·33d., compared with 0·25d.; Kirkcaldy, 0·413d., against 0·379d.; Norwich, 0·335d., compared with 0·318d.; Oldham, 0·379d., against 0·354d.; Warrington, 0·545d., compared with 0·489d. The item of coal at Coventry has an interesting point. The department claims the lowest cost in the country per unit generated. The average quantity of coal used per unit generated was 2·69 lbs., against 3·8 lbs. in the previous year; and this reduction represents no less than £6100 to the good. The total coal cost was reduced per unit generated from 0·164d. to 0·135d., and this is the figure that is claimed to be the lowest in the country. Though not a municipal undertaking, it is remarked that the dividend of the Westminster Electric Supply Company has been reduced 1 per cent., compared with the preceding year, owing to the increased cost of coal. Thus are seen various phases of the electrical business. According to the character of the business done, a slight rise in the price of coal may have an appreciably detrimental effect on generating costs; in other places, it will hardly be noticeable; while in another place, where the industrial conditions are favourable to a large, long-hour, continuous demand, despite increased cost per ton, the coal expenses per unit may be reduced to such an extent that a considerable lump saving is effected in a year. But let bad times come upon the industry of the town—industry of practically a single class—and another tale will have to be told. The Sunderland undertaking, a time ago, had some bad experiences through the troubles in the shipbuilding trade; the changed conditions have, however, again set the undertaking on firmer financial legs.

TRADES UNION CONGRESS.

Gathering at Newport (Mon.).

Over a hundred resolutions were included in the *agenda* with which the delegates found themselves confronted on Monday of last week, when they assembled at Newport (Mon.) for the forty-fifth annual Trades Union Congress. If the number of items of business was large, so also was the number of representatives who attended to deal with them. In all some 500 delegates were present, to represent 1,971,109 members of trade unions. The latter figure was a large increase on last year, when the number of trade unionists represented at the Newcastle-on-Tyne congress was 1,662,133. Among those attending was Mr. D. J. Shackleton, who was representing the Insurance Commission, and Mr. D. C. Cummings, on behalf of the Chief Industrial Commissioner's Department. The congress opened with a civic welcome by the Mayor of Newport (Dr. J. M'Ginn), who expressed the hope that in their discussions the delegates would "be guided by that spirit of moderation which they had exhibited in all their work."

This year's President was Mr. Will Thorne, M.P., and the business proper opened with the delivery of his address, in which the large increase in membership of some of the unions represented was pointed to as being worth noting, and as providing food for thought to those who believed that the trade union movement was dying and becoming played out. The two important "industrial battles" of the year—the strikes of the coal miners and the transport workers—were reviewed; the belief being expressed that the coal strike would take them one step nearer to the nationalization of the mines. In fact, the President said he understood that the Miners' Federation had already drafted a Bill to empower the State to take over the coal mines. After complaining that he could not recall a strike in which the forces of the Government were so obviously used to defeat the workers as was the case in London during the recent transport workers' dispute, Mr. Thorne gave it as his opinion that labour unrest cannot cease, nor can the tide of industrial revolt be stemmed, until remedial measures are brought about and the present social inequalities removed. What was wanted, he said, was a better distribution of wealth; for to-day the amount received by the workers was much less in proportion to total wealth production than ever it was. Forty to fifty years ago the annual wealth production was about 800 millions sterling, and the proportion received by the workers was just one-half. Last year the total wealth production was some 2000 millions sterling, while the amount received by the wage-earners was not more than about 800 millions, which was much less than one-half. To the statement that wages in some cases had doubled during the last fifty years, the answer was that wealth, as shown by the income-tax statistics, had far more than trebled in this period in the country. Remarking, in passing, that, in view of the revolutionary developments taking place in methods of wealth production and transit, the provision of a legal eight-hours working day was of vital consequence in dealing with the question of unemployment, the President came to the subject of compulsory arbitration, and pointed out that this was a principle which had already been rejected on numerous occasions when submitted to the congress. Judging from this fact, it seems obvious that if the Government bring in a Bill to deal in this manner with industrial disputes, it will meet with strong opposition at the hands of some trade unionists. The Trade Unions (No. 2) Bill does not appear to commend itself very warmly to Mr. Thorne; for he said that the unions would be well advised to consider carefully whether in the Bill there was any substantial increase of their present limited powers. In the concluding portion of the address the President's purely socialistic views found expression; but before this a few moments were devoted to insurance, and to a declaration in favour of a universal non-contributory scheme of State insurance. Many complaints had, he said, been made by trade unionists regarding the uncalled-for methods adopted by a number of employers in getting their employees to join the various collecting and insurance societies; and, in his opinion, "the main object and desire was to induce the workers to keep outside the trade union atmosphere." The solution he suggested was that the Government should take over the whole business and work it for the benefit of all.

The President having resumed his seat, the first resolution on the *agenda* came up for consideration. This asked the congress to re-affirm the resolutions passed at the last two similar gatherings in favour of the amalgamation of the present trade unions by industries. The argument was that at present, with their 1700 trade unions, they were anything but a "happy family," and that sectional unions were a source of real weakness. An amendment, however, was carried, asking the Parliamentary Committee to make efforts among the various trade unions in the same trade and business to secure amalgamation, so that one union might cover any particular trade or business; or, failing this, to secure the federation of all unions in the same industry. In the course of the discussion, one delegate, of a commonsense turn of mind, urged that the amalgamation of all unions was not really practical, and warned his hearers that if once they adopted a principle by which one section of workers could "down tools" and embroil the whole of the country in that movement, it would be a sorry day. He remarked that if a few months ago there had been a national strike decided upon, the unions would have been beaten back to work, and it would have required ten or twenty years to repair all the damage done. A very natural desire—in such an

assembly—having been expressed that any trade union requiring work performed on their behalf should have it done by trade union labour, and under trade union conditions, the proceedings were adjourned. The Osborne judgment was the first and foremost among the matters discussed at Tuesday's sitting, when the business was the consideration of the Parliamentary Committee's report. There was a little criticism of the Government, on the score of their dilatory action with regard to the Trade Unions (No. 2) Bill; but more life was infused into the debate when Mr. Havelock Wilson urged that other political matters should first receive attention by the Party in power. The discussion proved that the delegates are far from being of one mind in their views on this subject. The report of the Parliamentary Committee was duly adopted; but another long talk over the Osborne judgment and its effects took place later in the day, on a resolution that—

> Inasmuch as the Trade Unions (No. 2) Bill promoted by the Government denies to trade unions the right to exercise the principles of self-government, this Congress regards it with dissatisfaction, re-affirms previous decisions claiming liberty of political action, and urges the Parliamentary Committee to give strenuous opposition to the Bill unless it is so amended as to restore completely the political freedom enjoyed by the trade unions for over forty years prior to the Osborne judgment, as was demanded in the Bill previously promoted by the Labour Party.

The resolution, on being put, was carried by a large majority, but not before Mr. Havelock Wilson had made another spirited protest, and had uttered a few remarks which proved to be exceedingly unpalatable to some of his hearers. He confessed his belief that it was about time they had a little plain talk in the congress, as a preliminary to making good the deficiency. The unions had, he pointed out, insisted upon a compulsory levy on their members, to force them to pay for a political policy they did not agree with. They asked men to join a union for trade union purposes, and then a resolution was smuggled through in which these men were practically told, "We are going to charge you a shilling a year, and if you do not pay it we will prevent you from following your occupation." This was the cause of the trouble—they were trying to compel men to pay the levy whether they liked it or not. Among the trade unionists of the country, they would not find one man in ten who cared anything about the Osborne judgment. Even the mover of the resolution had confessed that there was no enthusiasm over the matter; and it was time they gave it a rest. Despite the Osborne judgment, means had been found by the unions of getting representatives into Parliament. When this resolution was out of the way, attention was devoted to some of the "smaller fry" among the items on the *agenda*, and the delegates separated—many of them, it may be conjectured, to ponder over what they had heard.

The morning only was devoted to business on Wednesday; but the time at disposal was made the most of, so far as discussion was concerned. On behalf of the National Union of Gas Workers and General Labourers, a comprehensive resolution was moved (and unanimously carried) in favour of a national system of education, free from the primary school to the university. It also demanded the appointment of a Royal Commission to inquire (among other things) into the finances of the universities and great public schools, and to issue a report containing a statement of the history and present value of those endowments which were originally intended for the poor. Then came a motion by the Miners' Federation that the question of secular education be eliminated from the subjects for discussion at any future Trades Union Congress. This, too, in spite of the President's expressed hope that the "delegates would have enough commonsense to vote it down," was carried, but only by a comparatively small majority. The remainder of the sitting was devoted to a debate (which was unfinished when the delegates rose for the day) on compulsory arbitration and the right to strike. Mr. Ben Tillett introduced a resolution asking, "in view of the necessity for some drastic action being taken," for a report by the Parliamentary Committee on the subject of conciliation and arbitration; remarking that the transport workers had recently lost half-a-million of money, but could not, after ten weeks' struggle, get to know what powers the Government possessed. Mr. Harvey, M.P., for the miners, said he and his friends were bound to oppose the motion. The miners, he argued, never appealed to the Government when they struck, neither did the employers. It was the nation who appealed to the Government. He had information that compulsory arbitration in Australia was an absolute failure. Mr. Tillett having agreed to amend the motion so as to leave simply to the Parliamentary Committee the power to inquire and report, Mr. Brace offered strong objection to the congress coming to any conclusion which would leave it open to the Government and the country to assume that the congress, representative as it was of organized labour, had departed from the decisions which it had come to year after year. No man present, he added, could be more opposed to strikes or lock-outs than he was; but he was never going to be a party to giving up the right of the men to cease work when it was the last and only alternative in defence of the rights of labour. Sir George Askwith and Mr. Isaac Mitchell had gone to Canada to inquire into the working of the compulsory arbitration machinery, and when they came back they would present a report on which the Government might act. The congress was faced with a great crisis; but if the policy hitherto adopted were adhered to, the Labour Members would be able to speak effectively in the House of Commons when the matter was brought forward, and would be able to tell the Government that organized labour was as much to-day as ever it was against the principle of compulsory arbitration. The cheers with which this statement was received did not, however, prevent Mr. Havelock Wilson from remarking that, as the result of careful inquiries in Australia and New Zealand, he had come to the conclusion that the Compulsory Arbitration Act might with advantage be adopted in this country.

On Thursday, after some further talk (in the course of which Mr. John Ward, M.P., remarked that they had either got to say that the Government should not interfere in a labour dispute, or to insist upon it being done in regularized fashion), the resolution was defeated by an overwhelming majority. Some miscellaneous matters were next disposed of, after which the congress turned its attention to the Insurance Act. There was unanimously passed an emphatic protest "against the unscrupulous tactics of the Insurance Companies in conspiring with numbers of employers to cajole and coerce members of trade unions into joining capitalistic and anti-trade union organizations," and against "the continued use of similar tactics to prevent workers joining trade unions." The Act was severely criticized from the point of view of the casual worker. The other business done included the formal approval of a general eight-hour day. The most important debate at Friday's sitting arose out of a desire on the part of the Parliamentary Committee to have a clear expression of opinion upon "certain ideas which had been enunciated during the past few months." The congress was invited to re-affirm its support of independent working-class political action; and the mover of the resolution voiced the belief that Syndicalism could only become a force in a society which had lost faith in itself. One delegate challenged his hearers to produce any authority showing that Syndicalism was anti-political; while another, in declaring against the general strike, made the noteworthy admission that "they had not calculated the resisting power of the capitalist class." Other speakers also had unkind things to say about both Syndicalism and the general strike, and the resolution was carried by a huge majority. Before the vote was taken, the Scottish Miners' delegate pointed out that the late coal strike was as near a general strike to fight capital as anything they had had in this country. "Did they," he asked, "injure the coal master? The only thing they hungered to death was their own class."

More miscellaneous business was carried through on Saturday, on which day the congress closed. Manchester was chosen for next year's gathering, when the President will be Mr. W. J. Davis. Among the resolutions passed was one expressing the opinion that the time had arrived when trade unionists should refuse to work with non-unionists. Events in the industrial world point to the fact that this course was decided upon long ago. Another asked the Government to nationalize industrial life insurance. A special conference is to be held next week to deal with matters arising out of the Insurance Act.

Golfers in the "S. B. G. I."

It will be remembered that last year a "Golfing Society" was formed in connection with the Society of British Gas Industries; and a silver challenge cup was presented by Mr. H. James Yates, to be played for annually—the play to be over eighteen holes, medal play. On the first occasion, the cup was won by Mr. P. B. de Clegg Mellor, who, on the present occasion, invited members to compete for the cup on his links at Stourbridge. The meeting took place last Thursday; but, unfortunately the holder was unable, through illness, to defend the cup. A large number of the members of the Society took part in the interesting event; and the cup was won by Mr. T. B. Walker, with a net score of 76. The three next were Mr. G. H. Pearson-Perry, Mr. H. M. Thornton, and Mr. W. D. Leach—each with a net score of 82. A vote of thanks was cordially passed to Mr. Mellor for his hospitality, and to the Committee of the Stourbridge Golf Club for allowing the match to be played over their links. The members of the Council of the Society of British Gas Industries and the competitors in the match were afterwards entertained at dinner at the Midland Hotel, Birmingham, by the Chairman of the Council, Mr. Thomas S. Clapham.

The Committee of the Newcastle Section of the Society of Chemical Industry have arranged for a series of lectures on "Some Modern Developments of Applied Chemistry" to be delivered during the coming session, and courses of five evening lectures each have been arranged. The subject of "Coal Gas Manufacture" has been entrusted to Dr. Harold G. Colman.

At the annual general meeting of the Society of Chemical Industry in New York last Tuesday, the report presented by the Council showed that the number of members on the register is now 4273, compared with 4300 at the last annual meeting. During the year, 225 new members were elected, against 245 before; and the losses were 253, compared with 244. The income for the year 1911 was £7031—an excess over expenditure of £798.

The cleaning of 48-inch and 60-inch pipes through which water is brought from the Chestnut Hill reservoir into the pumping-stations of the Boston (Mass.) water-works system, including Boston and adjacent towns, resulted in the removal of 8 cubic yards of material from 1000 feet of 60-inch and 500 feet of 48-inch pipe. The pipes were found to be coated with a heavy growth of *fredericella* and *spongilla*, a considerable portion of which dropped off the top and sides of the pipes when they were emptied.

AMSTERDAM INTERNATIONAL GAS EXHIBITION.

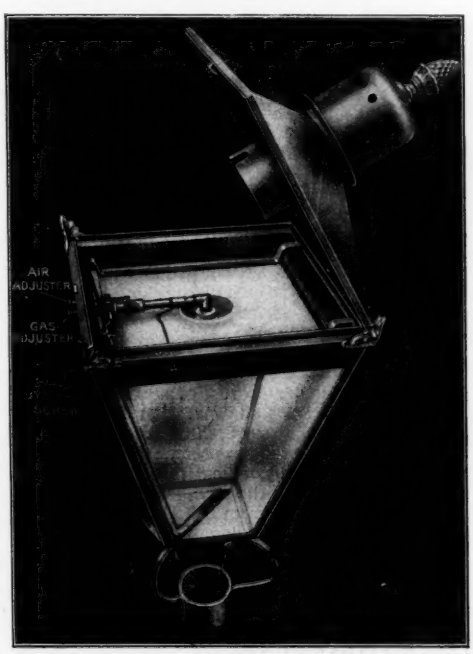
THE Committee for the International Gas Exhibition which will be held in the Paleis voor Volksvlijt [Industrial Palace] at Amsterdam from the 14th inst. to Oct. 6, we learn from "Het Gas," now consists of: Heer J. van Rossum du Chattel, of Amsterdam, Chairman; Heer J. Diephuis, of Amsterdam; Heer G. A. van Everdingen, of Amsterdam; Heer M. van der Horst, of Amsterdam; Heer O. S. Knotnerus, of Rotterdam; Heer M. C. Sissingh, of Rotterdam; and Heer Visser, of Amsterdam. The Jury for the Exhibition (which has been nominated by the Council of the Association of Gas Engineers of Holland) comprises the following members: Heer O. S. Knotnerus, of Rotterdam, Chairman; Heer J. E. H. Bakhuis, of The Hague; Heer N. W. van Doesburgh, of Leyden; Heer C. O. Heuvelink, of Batavia; Heer F. K. Th. van Iterson, of Delft; Heer C. T. Salomons, of Rotterdam; and Heer R. Zijlstra, of Amersfoort.

The exhibition will afford a comprehensive survey of the latest gas apparatus for household and industrial uses—including heating and cooking stoves, furnaces, geysers, gas-engines, and lamps and burners of different types for both high and low pressure, &c. Lectures and courses of instruction in cookery will be given in the afternoon and evening.

The Council of the Dutch Association are making arrangements for an organized visit of the members to the exhibition on the 18th inst. The visit will be preceded by a reception in one of the salons of the Paleis voor Volksvlijt. On the following day there will be a steamer trip on the Amstel, followed by a visit to the South or Third Amsterdam Gas-Works. In the evening the members of the Dutch Association will dine together in the Maison Couturier in the Keizersgaacht.

THE "IDEAL" STREET-LAMP.

THE varied requirements of an inverted burner street-lamp intended for erection under any possible conditions as regards position are well met in a lantern that has been placed upon the market by Messrs. Biggs, Wall, and Co., of No. 13, Cross Street, Finsbury Pavement, E.C. It possesses good qualities which should secure for it an extensive measure of popularity.



Biggs, Wall, and Co.'s New Street-Lamp.

Well made in heavy copper, and pleasing in appearance, the "Ideal" street-lamp has been designed to provide a storm-proof lantern which will allow of the gas and air regulation of the burner being accomplished without opening the lamp, it having been felt that in specially constructed storm-proof lanterns the burner cannot be adjusted to give its maximum lighting efficiency under normal conditions when the door of the lamp has to be opened for adjustment—thereby upsetting the ventilation arrangements. In the "Ideal" lamp, the object in view has been accomplished by providing the air-adjuster with a toothed wheel, which is operated by a pinion connected to a shaft passing to the outside of the lamp in close proximity to the head of the gas-valve needle, which is also outside the lantern. Thus it is possible to make the most delicate adjustments, even in a gale, with the lamp closed, and so working under normal conditions—and without any risk of having the mantle damaged by the wind. As is shown in the illustration, the lantern is fitted with a swing top, to give easy access to all the working parts of the lamp and burner; this swing top being held in position, when open, by a specially-constructed locking-joint, which prevents it from closing until required. The burner is of a solid and well-made type, from heavy cast brass. It can be easily removed and taken to pieces when needed; and it is obviously intended to stand a lot of wear and rough usage. The lamp is arranged in one, two, and three light styles, and is provided with separate bye-passes for each burner.

We have not inspected the lantern when lighted up; but the makers state that it gives an excellent light, with a low consumption of gas—a claim that would seem to be fully borne out by the fact that several gas engineers who have had samples on trial for some time past speak very highly of it.

STEAM SUPPLY TO BOILERS IN GAS-WORKS.

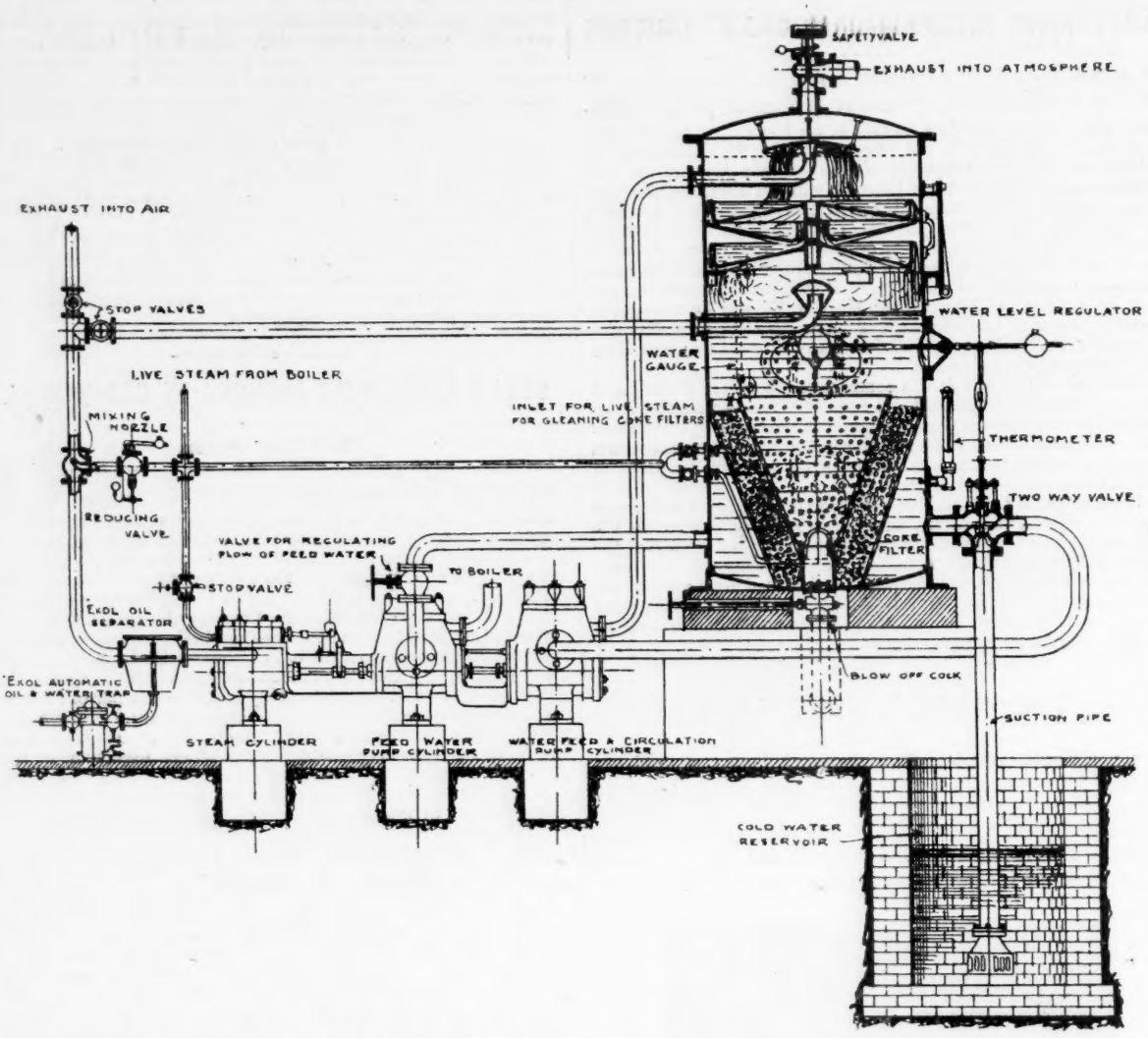
The "Exol" System.

THE advantages resulting from frequent examinations of the condition of the steam employed for driving motors must, we think, have at times been brought forcibly under the notice of engineers and managers of gas-works in the United Kingdom; and yet they do not appear to have given so much attention to this matter as their colleagues on the Continent and in the Colonies have done. It has been pointed out by Boiler Inspectors and by Inspectors of Factories that the time for the examination and scaling of the lower tubes of water-tube boilers ranges in different factories from twelve months to two weeks, with the result, in one case, that, in less than the first-named period, of the eight solid-drawn steel tubes of the best quality in the lowest tier of a boiler, one had to be renewed three times, three twice, and a like number once; so that only one remained intact. This was a case where the most modern water-softening appliances were in use; but, nevertheless, examination and scaling of the lowest tubes once a fortnight were found to be necessary, though the boilers were being worked at much below their guaranteed capacity (150 lbs. against 250 lbs.), were mechanically stoked, and had no fire-bars, so that forced draught was necessary. Very hard water, or condenser water, particularly when it has a hard "make-up," is bad for such boilers; and the best softening and separating appliances sometimes do not altogether prevent the passage of solid matter or oil. The presence of oil increases the danger; rendering the scale more porous and capable of holding more moisture.

The frequency of boiler cleaning and the expense it entails do not by any means constitute the whole of the loss incurred. The time for the preparation of the boilers and the actual cleaning of them has to be taken into account. During this period, the boiler duty is lowered, and the coal bill proportionately increased. The scaling of boilers is admittedly good up to a certain point. It is often protective—the layer of incrustation retarding corrosive action on the pipes. But the "certain point" is soon passed particularly in cases, which are by no means infrequent, where oil in the exhaust steam is carried into the engine and boiler by the admission of the uncleansed steam. If dirty steam were fully debited with the losses it entails, the bill must be heavy. It may be of interest to mention a few of the more noticeable of them: (1) Damage to boiler-plates; (2) cost of constant scaling; (3) lowered evaporation; (4) increased coal bill; and (5) heavy oil bill. If the waste of steam exhausting into the atmosphere be added, it will be realized that boiler-house costs are often unnecessarily high, particularly in gas-works, where possibly less attention is given to these matters than in other factories. A system which should prove simple in application and inexpensive to instal, and should, moreover, be guaranteed by the inventors or those responsible for it, which could overcome all these difficulties, and ensure clean steam and the utilization of exhaust for many useful purposes, and finally for heating and purifying the boiler feed-water, would be one which it might be supposed gas engineers aiming at retrenchment in works costs would be disposed to adopt.

In recognition of this fact, attention may be called to the "Exol" system, which we are informed is achieving remarkable results in boiler-houses on the Continent and in the Colonies, where much consideration has been given to steam economies. An idea of the system may be formed from the illustration given on p. 674, reference to which and to the particulars furnished upon it will assist the reader in estimating its value in conducing to the desirable results attending its installation, as shown by figures cited later. To the left of the illustration is seen a compact almost square case, which is the oil-separator; its object being to remove both oil and oil water from the exhaust steam. These products then flow freely, and with a good fall, to the piston vacuum oil-pump, which forces them into a filter, wherein the cylinder oil is separated from the oil-water emulsion in as perfect a manner as mechanical means will allow, rendering the recovered oil quite fit for immediate use again.

The saving effected on the oil bill alone where this system is installed may be easily computed by a consideration of the fact that more than 90 per cent. of the recovered oil is returned in a condition ready for immediate re-use. The residue flows from the apparatus in the form of an oil emulsion, and is of no account,



in either quantity or quality. Briefly, the cleansing of oily steam is a small, although distinctly profitable, part of the complete system which is in operation in many of the boiler-houses of the best-conducted Continental gas-works, where, we have been informed, as much as 100 per cent. utilization of the entire heat of the exhaust steam is ensured. No surface pressure feed-heater is required by the system; but its place is taken by the "Exol" suction feed-heater, consisting of a nozzle automatically regulated and actuated by the pressure of the exhaust. Its use secures immunity from waste, assisting the suction effect of the pump, and permits the entire heat of the exhaust steam to be returned again to the boiler by the lifted water. Thus the steam economy of the pump becomes of secondary importance, as all the exhaust gives off its heat to the water delivered.

It is generally admitted that the efficiency of a boiler is increased if fed with heated water; but the limitations of the many types of feed-heaters hitherto in use in this country leave much to be desired. It will be of interest, therefore, to give some account of the feed-heater and purifier which constitute so important a part of the "Exol" system. The apparatus (shown on the right of the illustration) consists of a wrought-iron casing, the interior of which is accessible by means of manholes. In the top part are trough-shaped cups or trays, situated concentrically above each other. The shape of the trays is specially designed to cause the rising steam to come closely into touch with the water as it drops from tray to tray—depositing its mineral substances, separated by the heat, and allowing the freed gaseous absorption to escape through a valve situated at the highest point of the apparatus. The heated water, purified, softened, and freed from gases, collects in the lower part of the heater casing, where it is kept at a constant liquid level by a float acting on a balanced valve which automatically regulates the inflow of water. All these details are clearly shown.

A feature of the feed-heater is its filter, which is of the drum type, made of aluminium sheeting, and filled with quartz sand. It is designed to revolve for cleaning purposes. The water enters it through perforations in the cylinder, and leaves it through the hollow axle on which the filter is supported on the one side. From the filter the partly heated water is lifted to the trays, either by an injector or a pump, whence it again drops through each tray, and once more comes closely into touch with the steam; thus being still further heated, softened, and freed from absorbed gases. This process is repeated several times. It may be pointed out that the cost of working the feed heater and purifier is practically *nil*, as the entire heat of the steam is returned to the boiler by the heated feed water.

Owing to the fact that the feed water treated in chemical purifiers deposits mud and scale in the pressure feed-heater and in the feed-water pipe, or in the boiler itself—thereby necessitating frequent and troublesome cleaning—it may be confidently stated that the "Exol" system, whereby the process takes place in the apparatus itself, is a great advance on anything hitherto installed in the boiler-houses of gas-works. Consideration of the following figures should, we think, induce gas engineers to inquire whether it might not be worth while to instal the system, under guarantee of efficiency and economy: A 50-H.P. steam-engine working with exhaust requires about 1500 lbs. of steam per hour. After leaving the steam cylinder and oil separation having taken place, there remain about 1400 lbs. of exhaust steam, with about 1,610,000 B.Th.U. available for the preparation of warm water in the feed-heater. This amount of heat is otherwise wasted into the atmosphere, and if used in the feed-heater will heat and purify 14,920 pints of water per hour from 60° Fahr. to 176° Fahr., or 149,200 pints (18,650 gallons) per day of ten working hours. This heat of the exhaust steam (containing 1,610,000 B.Th.U.) which has been made use of corresponds, at 60 per cent. efficiency of the boiler and the price of coal at 21s. per ton (11,700 B.Th.U. per pound of coal), to an annual saving in coal, at 3000 working hours, of 34·5 trucks, or equal to £358 6s. 8d. Against this large saving in coal has to be put the purchase price of the plant—say, a sum of £91 13s. 4d., which corresponds to an annual redemption of 450 per cent.

Lamp Characteristics.—Writing in an American electrical publication, Mr. M. Tappley says gas-mantles have a working life of 350 hours, carbon filament lamps 800 to 1000 hours, and metal filament lamps 1200 to 2000 hours. Gas-mantles fall to 80 per cent. of their original candle power in about 100 hours; but carbon and flaming arc lamps do not suffer decadence. Open arcs give only 10 to 15 burning hours. The Cooper-Hewitt mercury arc lamp falls to 75 per cent. candle power in 1000 hours, owing to a grey film deposit inside the tube, though the quartz type has a guaranteed life of 1000 hours without appreciable deterioration. Tungsten lamps are the least susceptible to voltage fluctuation of all incandescent lamps. The power factor of filament lamps is practically 100 per cent.; that of arc lamps, 80 to 90 per cent.; and Moore tubes, 90 per cent.

THE NORTH BRITISH ASSOCIATION MEETING IN ABERDEEN.

THE GENERAL PROCEEDINGS.

The Fifty-first Annual Meeting of the North British Association of Gas Managers was held in the Chemistry Class Room of the Marischal College, Aberdeen, last Thursday. The attendance numbered about sixty, including several representatives from England. Mr. SAMUEL MILNE, the Gas Engineer and Manager of the Aberdeen Corporation, the President of the Association, occupied the chair.

A CIVIC WELCOME.

Before the business commenced, the members were accorded a civic welcome.

The PRESIDENT, in the course of his introductory remarks, said he was very pleased to see so large a gathering of members. He esteemed it a compliment to himself that they should have come so far as Aberdeen to be present at the meeting over which he had the honour of presiding. When it was proposed last year that the meeting should be held in the city, there was some doubt as to its success; it being thought that the long distance might have an effect upon the attendance. In this respect, however, the choice had been justified; and he trusted the members would not be disappointed. They were honoured in having with them the Lord Provost of Aberdeen (Mr. Adam Maitland), Bailie Barron, Mr. J. A. Sangster (the Convener), and the other members of the Gas Committee. The Lord Provost had a message for them; and he (the President) called upon him to address them.

The LORD PROVOST, who had a cordial reception, said he was exceedingly pleased to be present and to offer the members, in the name of the Corporation, a very hearty welcome to Aberdeen. The Corporation hoped that their deliberations and their sojourn among the citizens would be both useful and very pleasant to themselves. He thought there could be no question as to the utility of these conferences, and the advantages to be derived from them. He had no doubt that even their esteemed President, who they in Aberdeen thought knew a great deal—and had not very much to learn—in the matter of gas manufacture, would be able to derive some benefit himself, and also, he hoped, to confer some benefit upon the members present. They had been very chary during the past few months in their use of the sunshine and of good weather; and he trusted that their economy would tell in their favour, and that they would now have a full supply for their benefit while they remained in the city. He hoped it would not be all gas with them, and that they would have time for a little of the lighter and more social element. Most of them hoped to have the pleasure of meeting one another in a social capacity in the evening. He trusted their excursions and their stay in the Granite City would be very pleasant, and that they would all go away with happy recollections of Aberdeen. The Corporation were exceedingly pleased to see the members; and he was glad to offer them a very hearty welcome.

Mr. SANGSTER said it gave him great pleasure, on behalf of the Gas Committee of the Corporation, to repeat to the Association the hearty and kindly welcome given by the Lord Provost. Last year, when the President suggested that the Association might be invited to Aberdeen, he had no hesitation in laying the proposal before his Committee; and the result was that they unanimously approved of the invitation being given. The Committee were most delighted to see so large a representation of the members; and it was a fitting honour to the President, who had at heart the best interests of the gas industry, and particularly those of the department of the Corporation with which he was more closely associated. The gas industry was a growing one, notwithstanding the stern opposition it had from other quarters; and with united effort, coupled with an earnest desire to do what was best, the industry would go on prospering in the future as it had done in the past. He had no doubt as to the benefit derived from such Associations as theirs. They tended to foster good feeling among the members; and the exchange of opinions on different matters connected with their duties was bound to be beneficial to the undertakings they represented. Looking at the amount of business to be transacted, he did not intend to detain them further, but would again offer them a very hearty welcome.

Mr. J. W. NAPIER (Alloa), in returning thanks on behalf of the Association, said the members tendered to the Lord Provost, Magistrates, and Town Council of the City of Aberdeen their very warm thanks for their welcome. It was fitting that an Association such as theirs should find themselves assembled in a University city, and within the walls of such an historic building as the Marischal College. The Association was composed not only of men of practical training, but men who must also have scientific and commercial knowledge. The gas manager of a few generations ago had merely to know things as they were practised inside the works; but to-day he must be both a commercial and a scientific man. He must be commercial, in order that he might better the financial interests of the concerns over which he deliberated; and he must be scientific, in order that he might be helpful to the community which his company or corporation were serving. He (the speaker) thought it was his duty to remind the Lord Provost and his colleagues that the gas profession had done very much good work in helping communities in large cities or in small towns. In the Leeds University there had been founded a professorship, the money for which was raised by the gas profession; and the Professor's duties were to carry out research and experimental work with the object of finding out the most efficient and the most economical methods whereby gas might be utilized for heating and power purposes. He thought the Lord Provost would agree that their Association was one of scientific men doing good work to communities in the matter of the smoke trouble—a problem which was becoming more and more important for local authorities to deal with. It was with great pleasure that they came to the University city with its towers and spires. They had had famous men in the past—men connected with literature, art, and science; and the characteristics that were dominant in the men of Aberdeen had found eminence in London and in the great cities of other countries. Before resuming his seat, he (the speaker) referred to the connection which the late Manager of the Aberdeen Gas-Works (Mr. Alex. Smith) had with the Association. Mr. Smith was, he said, a man for whom they had the very highest respect. He occupied the position of President of the Association in 1879; and that day his successor in the office of Gas Engineer and Manager in Aberdeen was his successor in the chair as President of the Association. Mr. Milne was a man of high integrity of character; and they remembered very well the paper he read on the abolition of Sunday labour in gas-works—thus showing the trend of his mind in the direction of helping working men. As President, he had proved himself capable; and as a member of the Association, he had done good work. The Aberdeen Corporation were to be complimented on having such a man to preside over the affairs of their gas undertaking. He (Mr. Napier) assured the Lord Provost that they came to Aberdeen with great hopes and great expectations; and he was satisfied that they would not go away disappointed. He was reminded of what their poets had said about Aberdeen; and, coming to the University city, he could not do better than quote from their own native-born poet, Walter C. Smith:

There's an old University town,
Between the Don and the Dee,
Looking over the grey sand dunes,
Looking out on the cold North Sea,
On the College Chapel a grey stone crown
Lightsomely soars above tree and town,
Lightsomely fronts the Minster towers,
Lightsomely chimes out the passing hours.
To the solemn knell of their deep-toned bell
Kirk and College keeping time,
Faith and Learning, chime for chime.

The PRESIDENT briefly acknowledged the welcome, and assured the Lord Provost and members of the Town Council that the Association appreciated the honour which had been bestowed upon them in extending to them so hearty a welcome.

Several apologies for absence having been intimated,

REPORT OF THE COUNCIL.

The SECRETARY AND TREASURER (Mr. Lawrence Hislop, of Uddingston) submitted the annual report of the Council, together with the accounts for the year ended the 30th of June. In the course of the report the Council said:

MEMBERSHIP.

The membership of the Association at June 30, 1912, was 253, compared with 260 at the close of the previous year—a decrease of seven. The membership is made up as follows:—

Ordinary members	163
Associate members	11
Extraordinary members	74
Honorary members	5
	253

The Council regret that the following members have ceased, by resignation or otherwise, to be connected with the Association:—

Ordinary Members.—Watson M. Cowie, Lockerbie, deceased; James Renfrew, Langbank, deceased; William A. Smith, Hawick, in arrears; William Young, Penicuik, in arrears.

Associate Member.—Robert D. Robertson, Airdrie, resigned.

Extraordinary Members.—John Dennis, Dalkeith, deceased; Andrew Gillespie, Glasgow, deceased; Peter Hurll, Glasgow, deceased; Henry Mungall, Melrose, deceased.

NEW MEMBERS.

In accordance with the rules, the Council desire to recommend the following gentlemen for membership:—

Ordinary Members.—Robert Philp, Gas-Works, Polmont; John W. Gordon, Gas-Works, Buckie; Alexander Wright, Strathmiglo.

Extraordinary Members.—John G. Stein, fire-brick manufacturer, Bonnybridge; R. Leslie White (Alexander Russell and Co.), Glasgow.

Honorary Member.—Robert G. Shadbolt, Gas Engineer, Grantham.

[In the course of the proceedings at Aberdeen last week, Dr. Harold G. Colman was also recommended for election as an Honorary Member, and was duly accepted.]

INSTITUTION OF GAS ENGINEERS' DELEGATE.

Mr. Samuel Milne, of Aberdeen, has been appointed to represent

the North British Association on the Council of the Institution of Gas Engineers for the year 1912-13.

COMMERCIAL SECTIONS.

Western District.—The total number of members of the Commercial Section (Western District) is 33, one of whom was added this year. The working of the section has been on the lines of former years, with the exception that the meetings have been mostly held at the various works in charge of members, instead of being held in Glasgow only; this resulting in making the meetings of greater interest to members.

On behalf of the Committee,
(Signed) PETER B. WATSON (Secretary).

North-Eastern District.—The work of the North-Eastern District Commercial Section continues to be appreciated by the members, whose fortnightly returns are sent in with fair regularity. The number of members at present stands at 31. During the past year there have been three meetings—viz., October (Aberdeen), January (Perth), and June (Dunfermline)—the average attendance being 17. Among other subjects under discussion were the following: "Publicity Scheme—Legality of Gas Corporations Subscribing;" "Tenant's Capital and Income-Tax Depreciation." Altogether, the Committee consider that the year has been a satisfactory one.

On behalf of the Committee,
(Signed) R. S. JOHNSTON (Secretary).

BENEVOLENT FUND.

The Council are pleased to report that there have been no applications for assistance from this fund during the past year. The fund now stands at £554 2s. 4d., and includes £20 which was transferred from the excursion fund, in terms of the resolution come to at the last annual general meeting.

THE ACCOUNTS.

Appended to the report was the statement of accounts for the year ended June 30 last, duly audited by Mr. David Spalding, F.S.A.A. On the general fund, there was a balance in the bank of £88; and altogether the affairs of the Association are shown to be in a sound financial condition.

On the motion of the PRESIDENT, seconded by Mr. GEORGE KEILLOR (Broughty Ferry), the report and accounts were unanimously adopted.

MEMORIAL TABLET TO WILLIAM MURDOCH.

The PRESIDENT then brought before the meeting a matter which he said would commend itself to all patriotic Scotsmen. The Council recommended that a memorial tablet should be erected upon the house in which William Murdoch was born. William Murdoch was born on Aug. 21, 1754, at Bello Mill, near Old Cumnock, Ayrshire, in which neighbourhood his ancestors had for centuries resided. One of their members recently paid a visit to Lugar, and inspected the house in which Murdoch was born, which was at present occupied as a farmhouse. He was shocked to find that the house did not bear any tablet, mark, or reference to the fact that that incomparable mechanic, that great benefactor to the human race, the inventor of gas lighting, was born there. The house occupied at Redruth bore a tablet on its walls commemorative of Murdoch's genius. The North British Association commemorated the centenary of gas lighting in 1892 by placing a bust of Murdoch in the Hall of Heroes in the Wallace Monument on the Abbey Craig at Stirling. He understood that in 1896 a gas-engine was placed in the Engineering Department of the University of Glasgow, to commemorate Murdoch. There was also a monument to his memory, in the form of a freestone obelisk, in Auchinleck Churchyard—a spontaneous tribute of admiration erected several years ago by a local master stonemason, who as a boy had repeatedly seen the inventor when he visited his old home. It bore the inscription: "To the memory of William Murdoch. Born at Bello Mill, in this Parish, in 1754; died at Handsworth in 1839." A bust of Murdoch was also to be found in the chancel of Handsworth Church. There might be more—he knew not. But, having just completed fifty years as an Association of Scottish Gas Managers—an Association representative of the great industry which was founded in 1792 by a Scotsman whose memory they adored, and to which they, as an Association, had already paid tribute—it would, in his opinion, be fitting, as marking their fiftieth anniversary, that they as Scotsmen, as a further mark of esteem and regard, should place a tablet on the walls of the house at Bello Mill, to record at least the fact that William Murdoch, the inventor of gas lighting, was born there. He therefore moved—"That a sum be voted from the funds of the Association to provide a tablet, suitably inscribed, at the birthplace of William Murdoch; and that it be remitted to the Council with powers."

Mr. J. W. NAPIER, in seconding the motion, said he thought the President and Council ought to be congratulated on having taken up this matter, and decided to see it carried through. Recently, while taking a holiday in Ayrshire, he visited Murdoch's birthplace, and was more than astonished to find that no mark whatever was on the house in which he was born. It was quite true that the Association had done good work in regard to Murdoch's memory in years gone by. But the matter of placing a tablet on his birthplace was not merely a sentimental duty; it was a duty which, as a technical association, they ought to look upon as an honour to themselves. The village of Lugar at present contained no memorial whatever of Murdoch; but a movement had recently been instituted whereby it was hoped a bust would be placed in the hall of the village,

The motion was carried.

The PRESIDENT then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—It has been said that Aberdonians are as hard as the granite of which their city is built, and as undemonstrative. Take my word for it, the hardness applies to the head, not to the heart; and a lack of effusiveness is no indication of shallowness of feeling. When they say "Welcome," the word comes with such spontaneity and goodwill, that you instinctively feel that all its other attributes are embraced in it.

After the very cordial reception which has been accorded to our Association by the citizens of Aberdeen through their civic head, Lord Provost Maitland, and the generous and most hearty welcome to the fair city of "Bon-Accord," I am sure that you feel, as I do, very much at home. My own wish for you is that your visit to "The Silver City by the Sea" may be at once exceedingly enjoyable and highly instructive.

In electing me to the honourable position of President, allow me to make this acknowledgment of my hearty appreciation of the favour you conferred on me, and to thank you most sincerely for your kindness.

We have before us to-day a programme which touches upon some of the subjects which are of importance to each of us, as affecting the manufacture and distribution of coal gas; and without making any invidious comparisons, it will be conceded that the outstanding feature of the Aberdeen meeting is the Inaugural Lecture under the William Young Memorial Trust. The lecture is to be delivered by one who ranks high in the Sciences, and whom we all regard as an eminent authority on various problems connected with the important industry in which we are engaged. In accepting the Council's invitation to deliver the Inaugural Lecture, Dr. Colman has conferred a very high honour upon the Association; and to-day, I am sure, we shall experience a pardonable feeling of pride in receiving the first fruits of the Memorial to which we so readily subscribed.

AN ERA OF PROGRESS.

Last year was recognized as our Year of Jubilee, as it marked the Fiftieth Annual General Meeting of the North British Association of Gas Managers. To-day we celebrate "Year One" of a new era—an era, we believe, that will be marked by still further progress in the economic production and purification of gas, and its wider application in the home and the factory.

Notwithstanding the competition we are faced with to-day, coal gas—the light of the past 120 years—is still the popular light; and not only will it continue to be so, but it will also play a most important part as the fuel of the future.

The progress which has marked the last decade (to go no further back) has been truly phenomenal. Improvements in carbonizing, purification, and distribution, together with improved markets for residuals, have all helped towards the cheapening of the production of gas, and thereby led to an increased demand for it. The increased demand, in turn, has led to further economies in production; and all these have been greatly assisted, if not actually brought about, by improved gas heating and cooking appliances, and the favourable terms upon which these may be had by consumers; also by the enormous improvements which have been made in gas-fittings, burners, and lamps, in which the inverted incandescent has stood out most prominently.

The reduced cost of gas is, therefore, not due to any one circumstance, but is dependent upon many; and while the old adage that "profits are made in the retort-house" is quite true, and must not be disregarded, it is, nevertheless, not the whole truth. There is little sense in making increased yields in the retort-house, if they are to be dissipated through leaking mains, or given gratuitously to consumers through the medium of faulty meters—meters which, because they are only a certain age, or only a few years out of the repairers' hands, are considered beyond suspicion, and regarded as accurate.

TESTING METERS "IN SITU" ESSENTIAL.

Dry meters are the greatest defaulters; and if we do not make systematic tests throughout the whole area of supply for partial indication, *in situ*, our unaccounted-for gas, which in Aberdeen is only 3½ per cent., would probably rise to an alarming figure.

It is surprising to find that several large undertakings continue to put out their meters for repairs. I am confident, from our long experience, that it is the more economic plan, and much more convenient, for large and medium-sized works to repair their own meters. The whole cost of overhauling, testing, and repairing of our meters, where the total number in use exceeds 42,500, does not incur a greater expenditure than £675 per annum—this being the average for the past five years.

It was surprising to me to learn recently that some large corporations in the South continue not only to use wet meters, but are regularly ordering new ones. Our policy for the past ten years has been to break-up wet meters in considerable numbers, crediting the meter repairs account with the scrap metal sold, and writing-off from capital account their full value at the expense of revenue. The result is that, whereas ten years ago we had 47 per cent. of wet meters, to-day we have only 24 per cent. As scientifically accurate measuring instruments, I hold that wet meters are preferable to dry, but on account of the trouble they give to consumers, it is bad policy to continue their use.

The days when gas managers may lightly regard consumers' complaints are past. The policy now is to give prompt attention even to the smallest details. Bona-fide complaints duly notified

to the management can be, and are, promptly attended to; and the fault, generally trivial, is immediately rectified; but general attacks, through the medium of a newspaper's correspondence column, or by anonymous letters, are absolutely useless, and are, as they should be, utterly disregarded.

An important factor in cheapening the production of gas is increased consumption. This can be promoted in different ways. I know a gas company in the North who have increased their output 12½ per cent. in twelve months through adopting a forward policy, which, in their case, has been fully justified. They issued a circular offering to fix up complete a gas supply to one burner and grill through a rent-free slot-meter, all for a lump sum of 10s., which barely paid the cost of the materials supplied. The orders came in more rapidly than could be overtaken, with the result that the company has had a record year. I know of no case where a liberal expenditure in getting new consumers on easy terms has not resulted in good business and justified the expenditure.

PUBLICITY: OCULAR DEMONSTRATION NECESSARY.

Much is being done in these days in bringing the claims of gas before the public by the British Commercial Gas Association, with their headquarters in London, and by individual gas companies and corporations in other parts of the country.

While recognizing the importance of such work as the British Commercial Association have set themselves to accomplish, I do hold most strongly that the claims of gas to be effective must be brought under the very eyes of a community. They must have ocular demonstration. The best means of obtaining this, in my opinion, is to hold a gas exhibition occasionally in the city concerned, and show by actual practice what can be done in lighting, heating, cooking, ironing, washing, &c. Such an exhibition is not complete without a display of gas-engines and high-pressure lighting for industrial purposes, as well as for interior and exterior illumination.

A gas exhibition of this nature was held at Aberdeen six years ago with excellent results. Another was promoted in October of last year—one of the commodious skating rinks lending itself admirably for the purpose. The application of gas for its many purposes was shown; a suite of rooms was laid out; cooking demonstrations and lectures were held in different centres throughout the city; public streets were illuminated with high-pressure gas. There were twenty exhibitors; and the building was visited by tens of thousands during the fourteen days it was open to the public. The total cost to the Department was only about one hundred guineas—practically the sum which the Corporation were asked to contribute annually towards the work of the British Commercial Gas Association. In consideration of this, is it surprising to find that gas committees believe that their contributions can be more usefully applied in local enterprise?

FREE COOKING APPLIANCES.

An exhibition by itself on the lines indicated is not sufficient. It is of little use showing people how much convenience and comfort can be had by the use of gas unless you give them also the necessary appliances, if not free, at least upon such reasonable terms as will lead to their adopting them.

The Aberdeen Corporation, following the lead of some of the corporations in the South, considered the question of free cooking appliances. The matter was remitted to me for consideration and report. I went into the matter prejudiced against absolutely free cookers; but after a careful study of the subject, I was compelled to heartily recommend their adoption. The policy adopted by the Aberdeen Corporation in October last was to fix, free of cost and without rental, one gas-cooking appliance to each approved consumer. The articles embraced high-grade cooking-stoves in four sizes, a range-plate, or grill, with side boiling-ring. Gas-fires and radiators continue to be hired at moderate rentals and fixed free. The result has been that, whereas twelve months ago we had 3548 cooking appliances, and 1492 gas-heating appliances—a total of 5040 on hire, to-day we have 9408 cooking appliances on loan, and 3121 gas-heating appliances on hire, or a total of 12,529.

The average increase in output of gas during the summer months of this year over last year has been seven millions per month, or over 17 per cent. There is yet a large field in Aberdeen for further exploitation. The generous policy adopted by the Council in regard to gas appliances—coming, as it did, on the back of a 3d. per 1000 cubic feet reduction in the price of gas—has been taken advantage of by the consumers in a manner which clearly showed their hearty appreciation.

WHAT THE MANUFACTURERS HAVE DONE.

While the gas engineer has been developing the productive capacity of the plant at his disposal, and engaging his attention to economize in the manufacture of the gas, it is exceedingly gratifying to find that numerous experts have been assiduously devoting their time and attention in experimental research, in order to produce apparatus to yield to the consumer the highest possible efficiency.

There are now very few manufacturers of gas heating and cooking appliances of any standing who have not their well-equipped experimental laboratory and staff of highly-trained technicians and chemists. The result is that we now have appliances which we can with confidence recommend as thoroughly efficient, and economical in the consumption of gas.

It is due to these firms that we, as a body of gas engineers and managers, should take this opportunity of paying our tribute of appreciation, praise, and gratitude for their enterprise. We recognize the good work they have already accomplished, and hope that the success achieved may lead to yet greater accomplishments.

GAS-FIRES.

The deep-rooted prejudice to the gas-fires of other days is slowly but effectively being lived-down. The modern gas-fire, with its scientifically constructed burner and non-lighting-back device, its air and gas adjustment and pillar fuel, its plain but pleasing design, is much in demand, and particularly in houses of the artizan classes, where labour-saving is of such moment. Experience has shown that in Aberdeen the consumers will not purchase gas-fires; but at a moderate rental and fixed free they are much sought after, as the figures already quoted indicate.

WHY NOT FREE FIRES?

The question is sometimes asked "When you admit that it is sound policy to give gas-cooking appliances free of rental, why do you not also give gas-fires?"

My views on this question are perfectly clear, and, I think, quite logical. Gas-cooking appliances are not taken into the house for ornament or occasional use. They are taken with the distinct purpose of using them daily, and particularly for use in the summer months—the very time that gas is not used to any great extent for lighting. They are, therefore, a means of bringing into use plant which would otherwise be lying dormant and quite unproductive.

With gas even as low as 2s. 3d. per 1000 cubic feet (which is the present price in Aberdeen) gas-fires are only used very sparingly. They are mostly fixed in drawing-rooms or bedrooms, and in the parlours of the artizan classes. They are for intermittent use only—for an hour or two on an occasional evening, or to take the chill off the bedroom on very cold nights. Further, gas-fires are mostly used during the dark months, at a time when our generating plant is taxed to the utmost. A general use of gas-fires would necessitate a greater expenditure of capital to meet the peak-load of winter, which, in turn, would result in a greater percentage of idle plant in the summer time. For these reasons, I hold that one is quite justified in placing the gas-fires on a different footing from the cooking appliances.

Apart from those gentlemen who get an unrestricted supply of free gas as part of their emoluments, I think the personal experience, even of gas managers, is that gas-fires are only used in certain rooms, and only very occasionally. The reason for this is undoubtedly a consideration of cost. When gas can be supplied at about (say) 1s. 6d. per 1000 cubic feet in a city so far removed from the coal-fields as Aberdeen is, wonderful changes will have taken place in the manufacture, and a change in the policy of renting gas-fires will probably also have been adopted. This, however, is at present beyond the reach of practical politics.

DIFFERENTIAL RATES.

Some managers have advocated the giving of gas for cooking purposes at reduced rates. But why should this be? Is not gas lighting, after all, the mainstay of our industry? Does it not bear by far a greater ratio to output than gas used for all other purposes put together? To cheapen the gas for purposes other than lighting may, and probably does, mean that the lighting consumer has to pay more heavily for it. In other words, we would be keeping up the rate for lighting, and giving our competitors an easy walk-over. Gas will easily hold its own against its competitors for cooking and heating; and we do not need to worry about reducing the cost for these purposes. But electricity is making a bold bid for supremacy in the matter of lighting. It has claims which we cannot disregard. It is for us to hold that which we have; and while looking for more, certainly we must be exceedingly careful that we do not prejudice that which we have.

A better way, to my mind, would be to supply all gas used during the four summer months at a reduced rate—no matter for what purpose it is used. By this means, you get away from the necessity of installing discount or duplicate meters. There are few of us who do not give reduced rates for motive power. This became necessary on account of the introduction of suction gas plants, with which we were brought into competition. In the case of cooking and heating, we have no competitor which we need seriously consider.

HYGIENIC CONSIDERATIONS.

Much has been written of late in regard to hygiene, and the need for pure air in the home. The advantage of gas lighting in promoting circulation of pure air in living-rooms has been demonstrated time and again; but must it not be admitted that, even in this enlightened twentieth century, our modern dwelling-rooms are most unscientifically ventilated. The only properly constructed ventilator in most rooms is one whose primary function is not to remove the deleterious products exhaled from the human system, but for the purpose of withdrawing the products of combustion in the grate.

Windows and doors are made to open, and these are used for ventilation purposes; but neither effect a sensible, safe, or comfortable means of maintaining a pure atmosphere, and they form a very poor substitute for a natural up-draught ventilating system. What could be simpler than to construct fresh-air inlet ducts in the skirting boards and outlet ducts in the frieze or ceiling? These could be made effective without being unsightly, and, if adopted, would give gas lighting a tremendous preponderance of advantage over electricity. The air, polluted by the products of respiration (oft-times laden with disease germs), together with

cremated dust particles, would, with the stimulating and circulating effect of the heat from the gas-flames, be carried naturally upwards through the ventilating ducts, thence to an up-draught ventilator on the housetop. This is a matter which may some day be taken up seriously by the Public Health Authorities, and is, I think, worthy of the best consideration.

ADMINISTRATION WITHIN THE WORKS.

Our thoughts so far have been almost exclusively taken up with considerations more directly applicable to the outdoor or distribution department. Let us now consider events which have a more direct bearing upon the administration within the works.

CARBONIZATION.

Never in the history of gas lighting was there a time when the industry showed more vitality or a greater determination to improve the process of carbonization, and to get the last atom of value—gaseous, liquid, and solid—out of the coal at its disposal. Never was there a time when the gas manager was more concerned in, and followed more closely, the various methods employed in handling coal from the moment it enters the works until it leaves in the form of coke. To this end, his engineering talents have ample scope for their application. Physical and chemical science have assisted in attaining yields of gas and residuals hitherto unknown; and his commercial instinct has led him to find increased revenue for his residual products, all of which have materially assisted him in selling the chief product—gas—at a figure much below anything attained before.

The choice of horizontal retorts with heavy charges, verticals, or coke-oven practice, is the absorbing problem of the hour; and their suitability to local conditions must be considered by each one individually. Much has appeared in the Technical Press relative to each system; and at the moment it is a difficult problem for the unbiassed to determine with which type his preference should rest. That excellent work is being done by horizontals with full charges has been shown, while verticals would appear to have at least equal claims. In certain localities it might be found that coke-oven practice should be followed. But as "Carbonization" forms the subject on which Dr. Colman is to lecture to-day, I shall not trespass, but await with great expectancy and interest to hear what he has to tell us on the subject.

THE NATIONAL COAL STRIKE.

The current year will be singled out as the year of Industrial Unrest, which reached its climax in the National Coal Strike—a movement which affected the nation and the world to an extent which, in these days, should not have been possible. For six weeks practically no coal was raised in the country; for some weeks previously, the deliveries were bad; and for nearly two weeks after the pits were opened supplies were still very unsatisfactory. The gas industry, taking warning from the railway strike, which preceded the coal strike by some months, had good supplies laid in, and, with a very few exceptions, tided over the strike without much trouble. It taught us, among other things, that a stock of coal equal to the requirements of six weeks in the depth of winter is no more than sufficient to have by one for emergencies; and that a carburetted water-gas plant is a most valuable asset to a gas-works of any magnitude. Surely, too, it has taught the miners how unwise was the step they took, and how little, if at all, they have benefited by their action.

EXTRA FINANCIAL BURDENS.

The price of coal for the current year has naturally been advanced, and, unfortunately, to an extent considerably above the actual extra expenses involved in the working of the Coal Mines Act. The cost of labour in our various centres has advanced. Freights also have advanced, due to increased cost of coal, and increase of wages to dockers and seamen.

Additional burdens have been laid upon us by the National Health Insurance Act—an Act which is anything but popular at the present time, and which the British public resent on account of the coercive nature of its application. It is an Act, however, which, with all its faults, will, in my opinion, be regarded by the end of five years as one of the most beneficent measures ever passed by any Government. The Unemployment Insurance applies to our industry only to a very limited extent, and that extent is by no means clear to the Government officials themselves who are responsible for the administration of the Act.

RESIDUAL PRODUCTS.

One redeeming feature of the past year has been the increased revenue from residual products. These have been exceedingly gratifying, and are likely to be well maintained during the present year. The Commercial Sections are capable of accomplishing good work in this direction. Restrictive legislation in regard to the working of residuals is threatened; but with this the Gas Companies' Protection Association will doubtless be able to successfully grapple.

Time forbids reference to the passing away of the illumination test for the calorific standard. The signs of the times indicate that a gas with fair heating value and 12 to 13 candle power will be regarded generally as sufficient for all practical purposes. But where a coal of good candle power can be got as cheaply as one of low candle power, or even if it costs a little more, I see no reason why it should not be adopted.

SCOTTISH CANNEL COALS.

Cannel coals so rich and abundant in Scotland are being left severely alone. Some of our Scottish gas managers now make a boast that they do not use an ounce of cannel coal. Let them beware of naphthalene troubles; for if their heats are right, they will certainly make their appearance. They will then have a sneaking desire to renew their acquaintance with cannel coal again. I believe the day of a limited use of cannel will return, and that very soon. Generally speaking, it is rich in gas, quality, and quantity; and though containing more ash in the coke, it is found to improve the general bulk of the coke for many purposes for which it is used.

A NAPTHALENE EXPERIENCE.

Naphthalene troubles, until recent years, were practically unknown in Scotland; but now they are being experienced here and there—consequent on the abandonment of the use of cannels, and the employment of higher heats in the retorts. This, again, is being minimized by the adoption of heavier charges. The writings of the late William Young have thrown much light upon the formation, behaviour, and arrest of this elusive hydrocarbon, and are referred to in the "Appreciation" circulated among our members last year.

But it may be news for some of my brethren to be told that naphthalene troubles can have their origin in the gasholders, and may not be due to any alteration of heats, or to any other detail in the process of manufacture. Who of us has not had some little trouble in the late autumn after a very strong sun has been shining all day upon the gasholders—producing a heat so intense that the ironwork becomes uncomfortably warm to the touch—followed at night by a keen frost, and the following morning by a report that a few lamp supply pipes have been stopped by naphthalene deposit? This, I think, will have been the experience of not a few of us.

That the trouble can be traceable in some instances to heat acting upon the hydrocarbon oil—the product of several years' operations with cannel coal—which is found in the interior surface of the water in the tank, and giving off a vapour which is saturated with naphthalene, was clearly proved by my own experience a few winters ago. Here the heat transmitted to the hydrocarbon oils in the tank was not due to the sun, but to other circumstances, which I shall briefly narrate. Water was being drawn by means of a pump from one of the gasholder tanks, and, after circulating through the tube condensers of the carburetted water-gas plant, the water was returned to another gasholder tank—the two tanks being connected near the surface by a 6-inch pipe. In course of time the temperature of the water increased, and, with it, naphthalene troubles arose throughout the entire distributing area, except the portion which was supplied from another gasholder station. The trouble continued for some weeks—gradually getting worse; and my whole attention was devoted to the manufacturing side, never thinking that the trouble lay within the gasholders.

One very frosty morning, a report came in from the works that excessive vapours were arising round the gasholder—the frosty air being accountable for the greater appearance than usual. This report was followed immediately by one from the Outdoor Department stating that a considerable number of lamps suffered through naphthalene during the previous night. Then the question occurred to me: "Has the one any connection with the other?" From that hour the gasholder which contained the hottest of the water was shut-down and kept shut for several weeks; and the trouble immediately diminished, and gradually disappeared. Needless to say, other ways and other means were devised for the cooling of the gas by utilizing the water in the gasholder tanks.

After my experience, I collected a little of the hydrocarbon oil from the tanks, and poured it into a Woulfe bottle, in which water had previously been placed. Gas was made to bubble through the liquid, and was led by a length of glass tubing through a condenser, and in the end of the tube, just before reaching the burner, a plug of cotton wool was placed. The liquid was kept at a temperature of 80° Fahr.; and soon the naphthalene flakes could be seen forming on the glass tube and on the cotton wool plug. We had, therefore, the same results repeated in the laboratory as took place in actual working.

In the autumn of the following year, when I reckoned upon immunity from further naphthalene troubles, I was much disappointed to receive a report one morning that six lamps were out in a particular district, and the following morning that a few were out in or about the same locality—the lowest level of the town. To effect a remedy, I tried passing the gas, as it went to the town, through the gasholder which was used as a relief holder for the carburetted water gas, in the hope that the volatile oil on the surface of the water there, not being saturated, would remove the naphthalene formed in the other holders. There was no further trouble with naphthalene from that day. It would appear as if the gas had taken up a portion of the volatile oil, and washed out the whole system. This was continued a little too long, I fear, for after that, we had several dry meters brought in for valves sticking. During the past two years, we have not had a single complaint due to naphthalene deposit, and our meter troubles are back again to their normal.

These are specimens of some of the little worries that are continually cropping up, and which make claims on our resourcefulness and patience, and go to prove the complicated and complex nature of the commodity with which we are dealing. And though the manufacture of coal gas has now been practised for nearly a

century and a quarter, it is a remarkable fact that we are still experimenting with it, and daily making discoveries.

AN ANNUAL CLEANING DAY.

There is an institution at the Aberdeen Gas-Works known as "cleaning day." It occurs once a year in the month of July. For about twelve hours that day no gas is made, and the whole of the connecting-pipes between the various pieces of apparatus are thoroughly cleaned out—inspection doors and covers having been provided to facilitate this. This is a custom which should be adopted in every works, large or small, because often in the course of cleaning, revelations are made which, had they not been attended to, would have caused trouble in the depth of winter, when it would be impossible to shut-down entirely.

The necessity for the systematic opening up of the centre-valve once a year for cleaning was vividly brought home to me one winter. There was a stoppage taking place in the purifiers or their connections, and it was gradually becoming worse, while everything appeared on investigation to be right, except that a systematic use of the pressure-gauge revealed a general stiffness or excess of back-pressure. It was found that the connecting-pipes, at the point where they join the centre-valve, were silted-up with tarry deposit—the accumulation of some years; and this deposit prevented the water from draining-back to the centre-valve, with the result that the carrying capacity of the pipes was reduced, and so caused the back-pressure. All these valves are now lifted and thoroughly cleaned once a year, and, as a further precaution, drain plugs are fitted on the bottom of each pipe.

Were gas managers to relate to each other the troubles which occur from time to time in their works or district, it would be very interesting and profitable to all; but because they are so often due to some trifling omission or want of foresight, or some other reason which may be taken as a reflection on their ability, they are generally left unsaid and are soon committed to the region of forgetfulness.

CONCLUSION.

I know that in a presidential address, one is generally expected to give a comprehensive and critical review of the outstanding events of the year during which he has held office. I have not followed this line to-day; and upon scanning the presidential addresses to our Association in late years, it would appear that considerable latitude is given to, or taken by, the President in the selection of topics he may choose to touch upon.

The leading events of the past year, were with beautiful conciseness and with marked ability, put before us by the Past-President of the Institution of Gas Engineers so recently as June last. We have been kept in close touch with current events throughout the country and the Continent by means of a Technical Press second to none in the world, and of which I cannot speak in terms sufficiently laudable to do it justice.

I shall not take up your time further, but trust that the various papers to be read to-day will lead to profitable discussion—full, yet short, and to the point.

Let us remember that we are here for the purpose of doing what we can to assist each other in the search after truth, so that each may help the other towards greater achievements in the economical production and distribution of gas. We are not here in the interests of self alone, but in the interests of our fellow-creatures, so that domestic felicity may be engendered in the homes of our clients by the introduction and application of a good and cheap gas capable of supplying their every want in the way of light and heat.

Mr. JAMES M'LEOD (Greenock) moved a hearty vote of thanks to the President for his address. He said they had all listened to it with feelings of very great pleasure, because it had been so clear and so lucid, so interesting from start to finish. They had had a very pleasant time listening to Mr. Milne; and he was sure they would accord to the President their hearty and united thanks for his excellent address.

The motion was carried by acclamation.

PAPERS AND DISCUSSIONS.

The four papers on the *agenda* were then taken; three being read and discussed, and the other presented. They will be found, with a report of the discussion, which followed the adjournment for luncheon, on pp. 693-701.

A TRIBUTE TO WILLIAM YOUNG.

The PRESIDENT introduced Dr. Harold G. Colman, who, as readers are aware, had consented to deliver the "William Young Memorial Lecture." Mr. Milne's remarks appear on p. 682; and they are followed by the text of Dr. Colman's lecture.

THANKS TO DR. COLMAN.

Mr. S. GLOVER (St. Helens), in proposing a vote of thanks to Dr. Colman, said he considered it a very great honour to be present to learn to appreciate fully the work that the North British Association of Gas Managers had done in keeping in memory the life and work of one who did so much to advance the position and knowledge of the gas engineer. They could voice their thanks to Dr. Colman in no unmeasured terms. If there was one subject to which their late friend was prepared to devote all his skill and peculiar abilities, it was that of carbonization. From his (the speaker's) close knowledge of Mr. Young during the last twenty years of his life, he could assure the members that William Young's spirit was with them that day. He could also assure Dr. Colman that the members of the North British Association were going to live the ideas that William Young tried to instil into their minds; were going to persist in using a phrase that he so often used—"pegging away;" and he could not help thinking that William Young's spirit was rejoicing that day that they had been able to embody so many of the ideas which he had hoped to live to see embodied. They had been able to get over many of the practical difficulties which he foresaw that they would have to face in working out a system of continuous retorting of coals, and which he persistently thought was a better method than the intermittent system.

The PRESIDENT, in seconding the motion, remarked that they had had an intellectual treat; and he asked Dr. Colman to allow his name to appear as an honorary member of the Association.

Mr. M'LEOD endorsed what the President had said.

Dr. COLMAN expressed his thanks for the vote and for his election.

THANKS TO CONTRIBUTORS OF PAPERS.

Mr. VASS (Airdrie) proposed a hearty vote of thanks to those who had contributed papers, which, he remarked, showed that the members, as gas engineers, had much to learn and much to unlearn.

ELECTION OF OFFICE-BEARERS.

The ballot for the election of office-bearers resulted as follows:

President.—Mr. James M'Leod, of Greenock.
Junior Vice-President.—Mr. John B. Scott, of Cowdenbeath.
New Members of Council.—Mr. J. W. Carmichael, of Barrhead, and Mr. David Robertson, of Dunoon.
Auditor.—Mr. David Spalding, F.S.A.A., of Glasgow.

Mr. M'LEOD, in returning thanks, assured the members that nothing would be wanting on his part to maintain and hand over to his successor undimmed and untarnished the fine record of the Past-Presidents of the Association.

PLACE OF NEXT MEETING.

Mr. M'LEOD submitted an invitation to the Association from the Corporation of Greenock to meet in that town next year; and he assured the members that nothing would be left undone to make their visit to the "town of rain and sugar" a thoroughly enjoyable one.

On the motion of the PRESIDENT, seconded by Mr. VASS, the invitation was unanimously accepted.

PRESENTATION OF THE PRESIDENT'S MEDAL.

Mr. G. KEILLOR then presented to Mr. Milne the President's Medal, and commented on the conscientious manner in which he had performed the duties of the office. Mr. Milne had, he said, been "one of the best Presidents the Association had ever had." He had presided over their deliberations with conspicuous ability; and not only had he been one of their best Presidents, but he was the best gas engineer Aberdeen ever had.

Mr. MILNE, in returning thanks for the honour conferred upon him, said he esteemed the gift as a memento of a very pleasant year of service. The term had been by no means arduous; and he had enjoyed the work, which had been very congenial.

OTHER VOTES OF THANKS.

Votes of thanks to the Senatus of Aberdeen University, Professor Japp, to the Council of the Association, and to the Secretary, brought the business to a close.

THE DINNER.

In the evening, the members, with their lady friends, were entertained at dinner by the Corporation in the Town and County Hall. The company numbered over 200; and, in the unavoidable absence (through family bereavement) of Lord Provost Maitland, Bailie Barron, the Senior Magistrate, occupied the chair.

After a sumptuous repast, an interesting toast list was gone through.

The CHAIRMAN, in proposing "The North British Association of Gas Managers," commented on the progress made by the Association, to the members of which he extended a very hearty welcome. Fifty years ago the membership was only 54; to-day it had a membership of 259. It was an Association which, he felt sure, should receive every encouragement and assistance from corporations.

Mr. MILNE, in reply, said he considered it a very high honour to be called upon to respond to so important a toast. Tracing the history of the Association, he said that it was in January, 1862, that the four originators of the North British Association met in the little town of Cupar-Fife, and recognizing the advantages which would accrue from intercommunication, organization, and association, they convened a meeting for July 30, 1862, in the same town. The next meeting was held in Broughty Ferry; and since that date no other meeting had been held north of Broughty Ferry until that day. At the outset, the Association was named the "Association of Gas Managers for the Four Counties of Fife, Kinross, Perth, and Forfar;" but shortly after the establishment of that Association, several others started in different parts of the country. In September, 1862, the Scottish Association of Gas Managers was formed in Edinburgh, with a membership of 22. Fortunately—and wisely he thought—the two amalgamated in September, 1866; and thereafter the Association (with the name it now bore, and with a membership of 54) began a more extended career of usefulness. The managers in the West of Scotland in 1872—not to be behind the times—organized an Association called the West of Scotland Association of Gas Managers; but in 1883, they joined forces with the North British Association—a step taken entirely in the interests of union and progress. There was no doubt about it, that the Association was doing, had been doing, and would continue to do, good work in the interests of the communities which they represented. It was a living force in their midst, as would be seen by the

developments which were taking place in practically every town. Increases were being recorded in the output of gas and decreases in the price at which it was sold. Of recent years, they had been faced with serious competition; but they were still increasing. Aberdeen was not a solitary case; for in practically every instance the demand for gas was now steadily increasing, notwithstanding the competition of the electric light. They, as an Association, esteemed it a very high honour to have received a civic welcome in Aberdeen; and it would be a memorable occasion in their history. As President, it was a particularly memorable day to him, because it coincided with 21 years' connection with the gas industry, and 21 years spent in the service of the Aberdeen Corporation. He felt that the great feast which had been spread before them was in his honour on reaching his "majority." He sincerely thanked the Corporation for their princely feast.

The toast of "The Gas Committee of the Aberdeen Corporation" was submitted by Mr. R. G. SHADBOLT, who said that, in the ancient city of Aberdeen no body of men required toasting in the true sense of the term more than the Gas Committee, because they contributed to the welfare of the community possibly more than any other body of men—civic or otherwise. They had entrusted to them a great proportion of the lighting and heating and comfort of the homes of the people, and they contributed to this in a manner which was unprecedented in the history of the ancient burgh. It must be a proud moment for Mr. Milne; and the Gas Committee had to congratulate themselves upon the fact that they had advising them (so far as official capacity would permit) a man who was in the forefront of gas engineers, not only in Scotland but throughout the United Kingdom. This was not sufficient if he were not backed up by a Committee of business men. The Committee had a splendid man, and they were prepared to accept his recommendations, with the result that the community benefited. The Aberdeen Gas Committee had the good sense to know that, though Mr. Milne was a home-born product, he was one whose advice they could follow. There were not many towns to which they, in England, looked to for guidance; but there were three or four. One was Aberdeen. They knew that when Mr. Milne decided that a certain thing was the proper thing for Aberdeen to do, he had very good reasons for deciding upon the course suggested; and they knew, moreover, that when his Committee thought it was right there was ten times more reason why the same course should be followed. Gas had gradually and unostentatiously made its way in such a manner that it had become one of the staple and most indispensable products of civilization, and, at the same time, a prop upon which civilization must depend and could not do without. If the recent coal strike had gone on another fortnight, there would have been absolute chaos; and the citizens of Aberdeen ought to unite in congratulating the Gas Committee for having provided for a supply of a commodity which had become absolutely necessary, and which no civilized community could do without. He coupled the toast with the name of Mr. Councillor Sangster, the Convener of the Gas Committee.

Councillor SANGSTER, in acknowledging, said he rose with great pleasure, on behalf of the Gas Committee, to acknowledge with thanks the kind remarks made by Mr. Shadbolt, and to thank the company for the manner in which they had received them. The Gas Committee of the Aberdeen Town Council were, to his mind, an ideal Committee. The business brought before them was carried through in such a manner as reflected the greatest credit on the Committee and their Engineer. The two years he had had the honour of presiding over their deliberations he could honestly say had been the happiest in all his public work. Never had he had a division in the Committee; and he hoped to be able to say so until the term of his office expired. In their Gas Engineer they had a man who had the interests of the gas industry at heart; and this was seen to no better advantage than in the gas undertaking connected with the Corporation. He could assure them that when a Committee had an Engineer in whom they could place implicit confidence, the work was very light indeed. The progress of the gas industry in Aberdeen was one which would bear comparison with many in the country. Ever since the Corporation took over the works in 1872, the progress had been steady year by year; and the past two years (during which he had presided over the Committee) he was proud to say were not by any means the least successful—in fact, they had been the most eventful of any year in the history of the undertaking. They had carried through one of the most successful exhibitions that had ever been held under the auspices of the Gas Department; and as showing the success of the venture, during the past year there had been an increase in the gas cooking appliances of about 6000, and of heating appliances of about 1600, which, of course, necessitated a considerable increase in the quantity of gas used. They had also reduced the price of gas, till it now stood at 2s. 3d. per 1000 cubic feet, and this had considerably added to the popularity of gas for heating and lighting. The past year had also been a record one in the make of gas, which amounted to 845 millions; being an increase of 27 millions over the previous year. He was satisfied that this was to continue, as they were still getting a plentiful supply of orders for both cooking and heating appliances; and if the suppliers of these appliances could deliver their orders more promptly, it would better their position considerably. It had been a great pleasure to him that, during his term of office, their Engineer should have held the important position of President of the North British Association of Gas Managers; and he thought he could speak with confidence when he said that Mr. Milne's conduct in the chair that day had been all that could be desired. It was very pleasing to the Committee to think that he had been made the recipient of the Association's gold badge, in respect of the high office which he had held among them. In concluding, he again thanked Mr. Shadbolt for the kind words he had expressed in giving the toast of the Gas Committee, and also to those present for having received them in such a hearty manner.

Mr. Daniel Macfie proposed the toast of "The Chairman," and Bailie Barron acknowledged it. The proceedings terminated with the toast of "Bon-Accord" and the singing of "Auld Lang Syne."

During the evening, an enjoyable musical programme was contributed by some well-known local artistes; while orchestral selections were a feature of the evening's entertainment.

THE EXCURSION TO DEESIDE.

On Friday, the members had an excursion to Deeside. The company, to the number of 163, journeyed to Ballater by special train, which left Aberdeen at 10.10 a.m. From there ninety of the party proceeded to Braemar by motor *char-a-bancs*, and had luncheon in the Invercauld and Fife Arms Hotels. The remainder of the party drove to Balmoral; and on their return to Ballater had lunch in the Invercauld Arms Hotel. After lunch, they visited the Falls of Muick. In the evening the party returned by special train to Aberdeen. The day's outing was enjoyed by all, despite the fact that the weather was not all that could be desired; and the beauty of "Royal Deeside" was much commented upon.

THE ABERDEEN GAS UNDERTAKING.

In connection with the meeting in Aberdeen of the North British Association of Gas Managers, the following account of the origin, progress, and present position of the Corporation Gas Undertaking will be of interest.

HISTORICAL OUTLINE.

The Aberdeen Gaslight Company was formed in 1824, when works were erected at Poynernook. For the first four years only oil gas was manufactured; the price being from 40s. to 50s. per 1000 cubic feet. The manufacture of coal gas was commenced in 1828, with a price of 15s. per 1000 cubic feet. In 1844 there was formed in opposition to the first Company the Aberdeen New Gaslight Company, who erected works on the present site at Sandilands. At this time the charge for gas was 9s. per 1000 cubic feet. An amalgamation of the two Companies took place, however, in 1846, when the works at Poynernook were abandoned. It was in 1871 that the Company's undertaking was transferred to the Town Council; the price of gas then being 5s. 5d. per 1000 cubic feet.

PROGRESS SINCE DATE OF TRANSFER.

Year.	Gas Made in Cubic Feet.	Gas Unaccounted. Per Cent.	Gas Rental. £	Residuals. £	Price per 1000 Cubic Feet. Ordinary. s. d.	Motive Power. s. d.	Prepayment. s. d.
1872	146,256,000	15·64	33,100	2,842	5 0	5 0	..
1882	260,743,000	13·79	44,556	5,203	4 0	4 0	..
1892	394,167,000	9·56	64,318	9,843	3 8	3 8	..
1902	626,653,000	5·79	93,701	16,856	3 2	3 2	4 2
1904	649,049,000	5·22	93,974	21,089	3 0	3 0	4 2
1906	691,506,000	5·08	90,164	20,467	2 9	2 6	3 7½
1908	780,958,000	8·08	92,688	25,790	2 7	2 4	3 2½
1910	794,755,000	6·15	92,445	26,41	2 6	2 3	2 10½
1912	844,795,000	3·64	92,046	31,296	2 3	1 11	2 6½

STATISTICS FOR YEAR ENDING 31st JULY, 1912.

Book value of gas undertaking	£378,155
Revenue	£125,490
Coals carbonized	72,100 tons
Oil used for carburetted water gas	396,800 gallons
Gas made	cubic feet 844,795,000
Gas sold	,, 814,038,000
Unaccounted for (3·64 per cent.)	,, 30,757,000
Maximum make of gas per 24 hours.	,, 3,934,000
,, output ,, ,,	,, 4,170,000
Gasholder storage capacity	,, 6,000,000
Number of meters in use	42,539
(Ordinary, 31,589; prepayment, 10,950).	
Number of gas cooking appliances on loan	9,400
,, gas fires and radiators on hire	3,120
,, gas-engines in use	313
Total brake horse power	4,600

Area of ground occupied by gas manufacturing and storage works—

Sandilands	9¼ acres.
Gallowhills	4½ ,,
Scatterburn	1¼ ,,
	15 acres.

DESCRIPTION OF WORKS.

Coal-Stores.—These stores extend along both sides of, and run parallel with, the retort-house, and are capable of accommodating upwards of 8000 tons of coal. About a mile of railway lines and sidings are laid within the works; and to convey the traffic to and from the railway stations and harbour rails, two powerful locomotives belonging to the department are employed. Powers to lay down lines and to conduct the traffic through the public streets were obtained by Act of Parliament in 1883.

Horizontal Retort-House.—This house is 370 feet in length by 56 feet in width, and contains 432 retorts, Ω shaped, 22 inches by 16 inches by 9 feet long, in four benches, having 27 through ovens with settings of eights. The benches are in one line, having a chimney 120 feet high between Nos. 1 and 2, and one 150 feet high between Nos. 3 and 4. The retorts are heated on the regenerative system with internal producers in a subfloor.

The house is equipped with two sets of West's patent charging and drawing machines—one set operating each side of the retort-bench. They are driven by overhead cotton ropes, which receive their power through helical spur-gearing from two horizontal steam-engines. There are three coal-breaking machines on either side of the house, with bucket elevators, which raise the coal to overhead hoppers, from which supplies are drawn to the hoppers which are fixed on the charging machines.

Stoking Machine Engines.—These comprise two horizontal steam-engines, with cylinders 15 inches diameter by 24 inches stroke, making fifty revolutions per minute—fitted with Proell's automatic steam expansion gear, and Corliss exhaust valves.

Inclined Retort-House.—This is a temporary building enclosing a bench of 36 Ω-shaped tapered retorts, 20 feet long, placed at an angle of 32°, in four ovens with settings of nines, and capable of producing 500,000 cubic feet of gas per 24 hours. An elevator and push-plate conveyors transport the coals from the breaker to the continuous overhead hopper.

Tar-Extractor.—The foul gas, on leaving the retort-house, is first treated by an Everitt patent tar and naphthalene extractor, capable of passing 3,000,000 cubic feet of gas per 24 hours.

Condensers.—These consist of four distinct batteries, each of twenty-two vertical cast-iron pipes, 15 inches diameter by 45 feet high, with cast-iron rectangular base-box.

Scrubbers.—These comprise rectangular and circular towers, containing tiers of wood frames covered with canvas and rough sawn boards, also one of Holmes's patent rotary brush-scrubbers, with steam-engine.

Tar and Liquor Wells.—These are underground, built of brick, and covered with stone slabs, and of ample capacity.

Steam-Boilers.—There are four Babcock and Wilcox patent water-tube steam-boilers, fitted with forced-draught furnaces, having a working pressure of 85 lbs. per square inch. There is also a Berryman feed-water heater and Lowcock economizer.

Steam-Pumps.—The feed-pumps for the boilers consist of one of Tangye's patent duplex pumps, and also one of Weir's patent upright pumps. There are five of Evans's patent double-acting pumps for circulating the ammoniacal liquor through the scrubbers, and pumping same, as well as the tar, to the chemical works adjoining, where all the residuals are worked up. There is also a 5¼-inch by 10-inch Deane pump for circulating the virgin liquor through the hydraulic mains.

Carburetted Water-Gas Plant.—In 1908, an installation of carburetted water-gas plant was introduced, comprising two sets of the Merrifield-Westcott-Pearson type, each capable of producing 750,000 cubic feet of gas per 24 hours. The plant includes generators, superheaters, fixing chambers, Sturtevant blowers, directly driven by Kerr steam-turbines, working at 1800 revolutions per minute, also washers, scrubbers, and condensers, tar and liquor separators, cyclone tar-extractor, and relief holder.

Two Snow steam-pumps deliver the oil from the storage tank through a Worthington meter to the apparatus. The effluent liquor is circulated through the scrubbers by two similar pumps. A Deane pump is used for raising the tar from the well to an overhead storage tank. The steam-boiler is of the Lancashire type, 28 feet long by 7 ft. 6 in. diameter, with a working pressure of 120 lbs. per square inch. The feed water gravitates from a Wright multiplex heater through a Worthington pump to the boiler. All pumps, turbines, and blowers are in duplicate.

A hydraulic coke-hoist, operated by a Tangye ram-pump, elevates the coke to a height of 36 feet, and deposits it in a large hopper over the engine-room, from which it is discharged through screened shoots into buggies on the operating floor.

The oil-storage tank is constructed of steel plates, is 35 feet diameter by 18 feet high, having a capacity of 104,000 gallons. The oil is run from the tank-waggons into an underground receiver, from which it is delivered into the storage tank by a centrifugal pump driven by a gas-engine.

Exhausters.—There is one exhauster passing 80,000 cubic feet per hour, with an engine having a cylinder 12 inches diameter by 24 inches stroke, and two exhausters each capable of passing 80,000 cubic feet per hour, both driven direct from the crankshaft of a steam-engine having a cylinder 14 inches diameter by 24 inches stroke. These are for dealing with coal gas. There is also an exhauster capable of passing 60,000 cubic feet of gas per hour, with an engine having a cylinder 12 inches diameter by 20 inches stroke, which can be used for coal gas or for drawing the carburetted water gas from the relief holder to the purifiers, &c.

Purifiers.—The purifier-house is 175 feet long by 114 feet wide in three sections, and contains four sets of water-lute purifiers, consisting of cast-iron boxes, ranging from 20 feet square to 33 feet square, with steel covers, which are raised, lowered, &c., by travelling hydraulic cranes. Each box contains tiers of purifying material, either slaked lime or oxide of iron. The foul oxide is lifted up through hatchways in the ceiling to the floor above, by means of buckets and steam-winches. After revivification, it is tipped back to the purifiers through canvas shoots. The slaked lime is prepared in a shed on the ground level, and is raised by a bucket-elevator, and deposited on a pan-conveyor, 160 feet long, which carries the lime to a central point in the reviving floor, and deposits it into barrows. The lime is then wheeled and tipped down canvas shoots into the purifiers below.

Station-Meters.—There are two station-meters, one capable of passing 60,000 cubic feet of gas per hour, and the other 140,000 cubic feet per hour. They register the gas manufactured immediately prior to entering the holders. At the outlet of the carburetted water-gas purifiers, a rotary meter, having a capacity of 40,000 cubic feet per hour, measures this gas, which then unites with the coal gas, and they together pass through the station-meters.

Gasholders.—There are four telescopic gasholders at the Cotton Street works, having an aggregate capacity of 2,140,000 cubic feet; one holder at Gallowhills, ½ mile distant, of 3,750,000 cubic feet; and one at Scatterburn, 3½ miles distant, of 100,000 cubic feet. The three-lift gasholder at Gallowhills was erected in 1894, and is contained in a concrete tank, 210 feet diameter by 41½ feet deep, and guided by twenty-four steel standards, each 123 feet high, braced together by four tiers of lattice girders.

Station-Governors.—There are three Cowan governors at the works—18-inch, 21-inch, and 30-inch respectively. There is also a 30-inch Peebles governor at the Gallowhills station to supply the west end of the city, as well as the outlying districts—Woodside, Bucksburn, Stoneywood, and Dyce, the last mentioned being six miles distant.

Dressing-Room and Dining-Hall.—The dressing-room on the ground floor is fitted with twelve patent wash-basins, and also two bath-rooms with hot and cold water. The dining-hall is on the first floor, and is a bright, well-ventilated apartment, fitted with hot-plates for cooking, and a self-feeding boiler which always contains a supply of boiling water.

Workshops.—There are workshops for both works and outdoor department. At the works the building is in close proximity to the retort-house, and comprises mechanics', blacksmiths', and joiners' workshops. The outdoor department have a four-storey building; the ground floor being a workshop for cutting and screwing pipes, cleaning and overhauling the cooking and heating appliances. The first and second floors are used as stores for pipes, fittings, stoves, meters, &c. On the third floor is the meter workshop, where they are examined, repaired, and tested.

Coal-Gas Experimental Works, Laboratories, &c.—Situated on the first floor of a building adjacent to the carburetted water-gas plant is the coal-testing plant, which comprises two retorts, condenser, washer, purifier, meter, and gasholder. The charge of coal is 11·2 lbs., or 1·200th part of a ton. The photometer is a 60-inch Sugg enclosed type, with No. 2 "Metropolitan" argand burner and 10-candle pentane lamp. The laboratory apparatus includes a specific gravity bell, calorimeter, Orsat apparatus, Somerville's sulphur test, Colman and Smith's naphthalene test, ash test, &c. Town gas, carburetted water gas, or gas from the experimental works may be tested at will.

High-Pressure Installation.—In the experimental works a Keith patent rotary gas-compressor, with gas-engine drive, has been fitted up for experimental purposes, and is capable of compressing 500 cubic feet of gas per hour, and delivering at 2 lbs. per square inch. There are various sizes of Keith lamps, from 60 to 1500 candle power, for indoor and street lighting, and other appliances.

Lectures on Gas Engineering and Manufacture.

In the "JOURNAL" for the 6th ult., it was mentioned that Mr. Alwyne Meade, Assoc.M.Inst.C.E., F.C.S., of the Commercial Gas Company, had been appointed lecturer on "Gas Engineering and Manufacture" at the Regent Street Polytechnic. We learn from the syllabus that the first-grade lectures will be delivered on Wednesdays, and those in the final grade on Mondays, on both evenings from 7 to 8.30 p.m., commencing on the 30th inst. The subjects dealt with in the first grade will be more fully treated in the final grade, in conjunction with others comprising important recent developments of the gas industry. At the close of the first-grade lectures each evening a series on "The Chemistry of Gas Manufacture" will be delivered by Mr. Frank E. Weston, B.Sc., Head of the Chemistry Department of the Polytechnic; and from January to April next year, he will deliver a second-year series at the close of the Monday evening lectures. The first-year course is arranged to meet the requirements of students having no knowledge of chemistry. The fee for either grade of Mr. Meade's lectures is 10s., and 5s. each for those of Mr. Weston.

Reinforced Concrete Reservoirs at East Cowes.

Two covered reservoirs, constructed on the Kahn system of reinforced concrete for the East Cowes Urban District Council, are approaching completion. They are 100 feet square, with a clear height of 17 feet between the floor and the roof; the overflow providing for a maximum depth of 16 feet. The floor slab consists of 6-inch concrete, interlaced with ⅜-inch rib bar, spaced in both directions at 14-inch centres. The wall slabs between the vertical buttresses or piers have horizontal reinforcing bars, spaced 4 inches to 12 inches apart at varying heights from the bottom, proportionate to the pressure. The roof slab is 3 inches thick, with ⅜-inch cup bar, 10½-inch centres. The maximum size of slab clear of beams is 5 ft. by 16 ft. 8 in. A foot of surface soil is placed on the top, with the usual ventilators for each bay. The east and west outer walls consist of seven 26 in. by 12 in. vertical buttresses, reinforced with Kahn trussed and cup bars opposite the cross-line of the columns, and twelve 24 in. by 9 in. intermediate buttresses, all standing upon a continuous beam 24 in. by 10 in., into which the roof beam and slab tie-bars are hooked. The remaining outer walls are constructed in a similar manner with nineteen 24 in. by 9 in. buttresses and 4-inch to 5-inch wall slabs between. No cross-beam at the head is required. The dividing wall is formed of five 27 ft. by 12 ft. and twelve 25 ft. by 12 ft. vertical buttresses of similar construction to the last, with 5-inch to 4-inch slab in the centre of the buttresses. The total cost of the works—including nearly a mile of main, duplicate meters, sluice-valves, hydrants, and electrical indicators, &c.—was £3300. The work has been carried out by Messrs. Brading and Sons, of East Cowes, under the superintendence of the Council's Water Engineer and Surveyor, Mr. Albert E. Barton, M.I.Mun.E., who prepared the scheme.

THE NORTH BRITISH ASSOCIATION AND WILLIAM YOUNG.

APPRECIATIONS BY THE PRESIDENT (MR. SAMUEL MILNE) AND DR. GEORGE T. BEILBY, F.R.S.—MEMORIAL LECTURE BY DR. HAROLD G. COLMAN.

THE PRESIDENT'S TRIBUTE.

At the close of the discussion on the papers read at the meeting of the Association, given elsewhere,

The PRESIDENT (Mr. Samuel Milne), introducing Dr. Colman to deliver the William Young Memorial Lecture, said the commemoration of the life and work of the late William Young, as most of the members there knew, had been the subject of much thought and consideration with successive Councils of the Association. The idea of publishing in book form his papers and contributions to the various Technical Societies and the Technical Press was relinquished in 1909 on account of the extraordinary expenses which would have been involved in the accomplishment of such an undertaking. But the importance of the subject would not admit of a suitable commemoration being lightly set aside; and, at the annual meeting held in Stirling in 1909, the matter was remitted back to the Committee, with power to add to their number, for further consideration. A meeting was duly convened, and a Special Committee appointed to deal with the subject. The result was that "The William Young Memorial Lectureship Fund" was established, to be devoted to providing a biennial lecture to be delivered at an annual general meeting of the Association. A sum of about £654 was subscribed by members of the Association, and a deed of trust was prepared under which the fund was permanently settled for the purpose for which it was raised. An "Appreciation" of William Young, together with an appendix—being an index to all Mr. Young's published writings and recorded utterances on Technology—was prepared by Dr. Alfred Daniell, an intimate friend of the late William Young. A copy of this "Appreciation," in book form, was issued to each member of the Association last year; and it formed a concise, comprehensive, and valuable little work, and was one which was worthy of a place on every member's bookshelf. A co-worker and admirer of the late William Young, in the person of Dr. Beilby, writing to him (the President) a few days previously, expressed great regret that he would be unable to be with them, on account of his having to attend the meeting of the British Association, which was being held at Dundee. He said: "I would gladly miss any or all of the social functions in order to be with you on this very interesting occasion for the North British Association of Gas Managers; but were I to leave Dundee on Thursday forenoon the main object of my attendance would be defeated." Unable to be with them in person, Dr. Beilby was with them in spirit; and, upon being requested to do so, he very kindly prepared a brief appreciation, as follows.

WILLIAM YOUNG, OF PRIORSFORD, PEEBLES.

AN APPRECIATION.

By DR. G. T. BEILBY, of Glasgow.

To his friends, the interest and charm of William Young's many-sided personality made its appeal now on one side and now on another—sometimes through the freshness and unconventionality of his ideas, and sometimes through the ingenuity with which he sought to carry these ideas to a practical issue. The breadth and daring of his attempts to grapple with those bigger problems of matter and of energy which are ordinarily allowed to remain in the dim background of the immediate problems of industry, and the intellectual vigour with which he dragged these big problems into the discussion of the most everyday questions, while it charmed those of his friends to whom the intellectual side of things makes an appeal, it left others of the more practically minded in a state of sheer bewilderment! By scientifically minded men of the more conventional type, these attempts to wrestle with big problems might be looked upon with coldness or indifference, and a merely superficial knowledge of the man might have led to his being hastily labelled as a crank. To those, however, who knew his stern intellectual honesty and his genuine intellectual humility, this misapprehension carried no sting.

After an intimate intellectual friendship with him which extended over more than thirty years, it is my deliberate belief that had the early life of William Young been cast amid intellectual surroundings, he would have won for himself the highest recognition as a pioneer in Science, and his name would to-day have been enrolled among the illustrious men of science of our time. Whether or not we deplore this loss to science will depend very much on our general attitude towards the intellectual, as distinguished from the practical, side of human progress. It appears to me that we may legitimately set the success he achieved in the latter field against the possible loss science has sustained.

We may regard William Young as a pioneer in a double sense; for not merely was he an inventor in the practical arts, but he was equally a pioneer in the continuous application of the scientific point of view to the problems which his inventions were intended to solve. While on one side he was an idealist, on another he was intensely practical; and the powerful critical faculty which he possessed was strongly coloured by his intimate touch with the practical side of things. Starting his career as a skilled craftsman, his first encounters with the laws of matter and energy took place when he found it necessary to turn these laws from their forbidding appearance as the barriers of progress into their more real and friendly rôle as helpers in the attainment of the practical ends which he had in view.

It has been truly said that science is one and undivided, that the distinction between science pure and science applied is false and unreal. But it must be recognized that there are two distinct sides from which the study of the laws of the physical universe may be approached—the purely intellectual and the purely practical. The inquirer who studies these laws for the sake of the intellectual satisfaction which this study has for a certain type of mind, the seeker after knowledge for its own sake, is certainly free from limitations and entanglements which hamper the inquirer who desires to *know* in order that he may *apply* his knowledge. But the inquirer who approaches from the practical side has certain advantages even in the search for pure knowledge. His practical applications are really experiments on a large scale, and his criteria of success are often more exacting in their requirements than those of the laboratory or study. But not only is the critical element thus strongly represented, but the constructive element must be equally in evidence; for the primary aim of the practical inquirer is to accomplish certain ends. He desires to build up, not to pull down. The critical attitude of pure knowledge is, by itself, generally fatal to the building-up either of new knowledge or of new inventions.

While it is convenient thus to differentiate the two points of view from which the study of the laws of Nature may be approached, we shall find, when we look closely into the life and work of the great pioneers of science and its applications, that in many cases, though the approach has been made from one or other of the two opposite sides, the two points of view have been blended in various proportions in each individual. James Watt (craftsman and inventor) gave to all subsequent students of thermo-dynamics the indicator diagram; while Kelvin (mathematician and physicist) gave his epoch-making inventions to the navigator and the electrician.

Though William Young was not privileged to carry the knowledge of his time into new regions, yet his claims to distinction do not rest only on the inventions of real practical utility which he produced, but even more on the inspiring influence which he exercised on those who were associated with him in the industries which he touched. He entered the stearine industry as a simple craftsman, but ere long he had grappled with the first principles on which the industry was based. Scarcely had he gained a footing in this industry before he was called on to take up a new undertaking—the distillation of paraffin from shale. The shale industry at this time was to a great extent still living on the traditions of its great pioneer, James Young. William Young took little heed of these traditions, but proceeded at once to lead the practice back to the first principles on which the original invention of James Young had been based; and straightway he evolved an apparatus in which shale could be distilled under those conditions which these first principles required. During the early years of the paraffin industry, the practice was obliged to accommodate itself to the commercial policy of the time. This policy was to produce a maximum output of lamp oil from a given installation of retorts and stills, even if the quality and quantity of the other products suffered thereby. Thus it came about that the retorts were externally heated to a very high temperature, and shale was passed through them as rapidly as it could be exhausted of oil. Steam was passed through the distilling shale in order to sweep the volatilized products out of the region of high temperature as quickly as possible. Thus, for commercial reasons, in the first instance, the practice had drifted away from the ideal conditions of distillation. In 1871, though the commercial conditions had changed considerably, there had been no general recognition that the development of the old vertical retort had taken place along lines which were unsuitable for the more modern conditions.

The 1871 retort of William Young was a remarkably perfect instrument for the distillation of shale at a minimum temperature. The oil it produced was unique in the quantity of solid paraffin it contained, as well as in its freedom from tarry and other high-temperature products of an objectionable kind. The industrial production of crude oil of this excellent quality at once established a new standard in the industry. Some of Young's views as to the means by which this new standard had been attained would now be regarded as fanciful, but the broad fact remains that it was he—a newcomer in the industry—who had led it back to the first principles enunciated by its founder, James Young. The 1871 retort was hardly a commercial success; but it was much more than this, for it led the way to a complete revolution in the

method of shale distillation. The story of this revolution has been told elsewhere, and cannot be enlarged on here; but its initiation is referred to because it illustrates the part which William Young so brilliantly played for the forty years of his association with the shale industry. This part can be described in six words: *He fertilized it with new ideas.* I believe that this is quite true also of the part that he played in the sister industry of coal-gas making.

It is a matter of no small satisfaction to me that I was one of the first converts to Young's views from within the traditional circle; for it was during the process of conversion that I fell under the spell of his personality. Under that spell it was my privilege to remain during the rest of his life. The mental pictures of days and nights spent with him in his little works at Magdalen Bridge, near Edinburgh, in the spring of 1872, will always remain among the most vivid in my mental picture gallery. The sheer joy of unrestrained interchange of ideas on all that concerned our work and its interests was obviously quite mutual, and its general effect was more intoxicating than nectar. During the preceding years I had been studying the nitrogen in the shale with a view to the recovery of a larger proportion of it as ammonia. The subject was new to Young; but he at once caught it up, and we fell to discussing seriously the problem of how to win from the shale, not only the whole of its solid paraffin, but also the whole of its nitrogen as ammonia. It was not till the spring of 1881, or nine years later, that we quite independently produced a form of retort by which a fair approximation to this ideal could be reached. From that time till he was removed from among us by death, we stood side by side, sharing the troubles and anxieties as well as the sucesses of our joint invention.

In industry many of the most useful inventions are necessarily short-lived. They serve their turn till they are displaced by newer developments. The inventions of a generation ago appear of slight importance to the industrial and commercial leaders of to-day. For this reason, I believe that in founding a memorial to William Young, we shall do well to make it clear that it is not merely for his inventions, however important these may have been, but rather for the mental qualities, of which these inventions were a partial expression, that we desire to honour his memory. It is in this spirit, therefore, that these lines of appreciation have been written.

Proceeding, the PRESIDENT said that they honoured that day in a practical manner the memory of a practical man, possessed of an intensely scientific mind; and such an occasion as this would have been very dear to the heart of their departed friend. As with the shale-oil industry, so with the gas industry, William Young "fertilized it with new ideas." He enunciated theories and evolved practices of which they to-day were reaping the benefit. The first lecture under the William Young Memorial Fund fell to be delivered that day. The Council congratulated themselves on having secured for this purpose the services of one who was recognized as an eminent authority in all problems connected with the gas industry. Dr. Colman required no introduction to an Association of Gas Managers. His works were well known to them, and they felt very highly honoured in having him with them and to speak upon that all-important subject "Carbonization."

Dr. COLMAN then proceeded to deliver the following lecture.

WILLIAM YOUNG MEMORIAL LECTURE.

By Dr. HAROLD G. COLMAN.

Mr. President and Gentlemen,—In the first place I have to thank you for the honour you have done me in asking me to deliver the first of the William Young Memorial Lectures founded by your Association—an honour that I deeply appreciate, not only for its own sake, but still more for the fact that it enables me to associate myself with the tribute to be paid to that great mind and master intellect whose work extends over almost the whole range of the technical problems of the gas and shale-oil industries, in most of which he was a pioneer worker. He has left behind, in his published writings and by his work, a legacy which has been, is, and still will be of the utmost value in these industries; and his example as a great searcher after truth serves as an incentive to all to follow the same path.

Nevertheless I am sorry that the inaugural lecture could not have been delivered by one who had had a much longer and a more intimate personal acquaintance with Mr. Young than I can claim. It is a great regret to me (and I know to all of you) that considerations of health, as well as his many other engagements, precluded Dr. Beilby (whose name is so indissolubly connected with that of William Young) from undertaking the task. We rejoice that his health has improved, and express to him our heartfelt thanks for the valuable and graceful words of appreciation of Mr. Young that he has sent for reading at the meeting, and which gives to the day the personal touch it might otherwise lack. Further, as you may know, Professor Smithells was to have given this inaugural lecture; and he likewise has been prevented from doing so owing to the state of his health. We are thus prevented from hearing the lecture from him to which we had looked forward; and I am sure you will all join with me in hoping and believing that the rest of the vacation will restore him to full health and strength.

As already mentioned, Mr. Young's activities ranged over the whole field of the numerous processes involved in gas manufacture; and it is obviously impossible to attempt to deal in a single lecture with all these subjects, even in a very cursory manner. This is, moreover, unnecessary, as it has already been done in so admirable a manner in the "Appreciation" laid before you by Dr. Daniell at your last year's meeting in Glasgow. To-day I have been asked to treat of matters connected more particularly with the subject of carbonization, to the inner knowledge of which the work of Mr. Young added probably more than that of any other investigator.

The gradual development of Mr. Young's work in carbonization during a period extending over nearly fifty years is in many respects of great interest in connection with the changed conditions which have taken place in that period in the requirements of the gas industry. At the commencement, his connection was with the production of gas for use as an illuminant, and his work was done in the endeavour to obtain from the coal the maximum amount of light units when the gas produced was burned with a luminous flame. Then on entering the shale-oil industry, his object was to obtain from the bituminous material the maximum amount, not of gas, but of valuable liquid products of distillation, and the working-up of the latter into commercial oils. Along with this, and as a direct result of his work in the shale-oil industry, he was able to give most valuable help to his old love, the gas industry, by showing the principles by which the more easily condensable vapours, such as benzene, on which the illuminating power mainly depends, could be retained in the gas, and also the converse—namely, the means by which the deleterious vapours, especially naphthalene, can be removed.

In conjunction with Mr. Bell, Mr. Young in the well-known "Peebles" process, provided the gas industry with a highly-efficient means of increasing the illuminating power of coal gas, as a substitute for the use of cannel coal—then becoming so scarce and expensive. But at the later period of his life, when again he turned more especial attention to the carbonization of coal, the old order was changing. The great extension of the use of gas for heating and power purposes, and its employment for illumination purposes in the Welsbach burner, had then rendered the illuminating power of secondary, and constantly decreasing, importance, and the chief object in gas manufacture was becoming no longer the production of the maximum number of light units from a ton of coal, but the maximum number of heat units, and the primary importance of the vaporous constituents of coal gas had passed away. Although by training and the whole trend of his life-work, Mr. Young was associated with the production of high illuminating power, his broad mind fully realized these changed conditions, and he effectively discussed them in the last paper he contributed to the proceedings of this Association in 1903. Nine years have passed since then; and in the interim, the importance of the illuminating power of the gas when burned in open flames has steadily decreased. But the official world moves slowly; and it is only in the present year that the fact has become recognized in legislation, by the replacement of an illuminating power standard by a calorific standard, in the case of the Acts of two gas companies passed during the present session. Two English companies have, therefore, or will shortly have, the same freedom that has for years been enjoyed by many other gas undertakings in Germany and elsewhere; and it is to be hoped that the same conditions will rapidly extend, not only in England, but even North of the Tweed.

The subject of carbonization is so complex that the time available makes it necessary for me to confine myself to the consideration of special parts of the process and their influence on the above-mentioned aim of obtaining from the coal the maximum amount of heat units in the form of gas, the great bulk of which is made up of combustible constituents. I propose to deal with the general aspect of the matter only so far as is necessary for the proper understanding of the points particularly treated of.

Highly complicated as are the changes which occur when coal or other bituminous matter is strongly heated in absence of air, it is, nevertheless, possible to recognize several fairly clearly marked stages in the process. In the first stage, the coal (or rather some of the complex constituents of the mixture we term coal) commences to undergo decomposition when the temperature reaches about 300° C. (572° Fahr.), and between 300° and about 450° C. (572° to 842° Fahr.) the larger proportion of the volatile matter in the coal is evolved. If this latter temperature is never exceeded, the residue left behind is infusible whether or not the original coal is of a caking character. But coal of the ordinary character used for gas making, roughly still contains a fourth of the total volatile matter present in the original coal, owing to the presence in it of considerable quantities of hydrogen and oxygen, as well as some nitrogen and sulphur. This consists, in all probability, of a mixture of the substances present in the original coal which do not undergo decomposition at 450° C., with products produced from the decomposable constituents, which require a higher temperature for their further decomposition. The larger proportion of the three-quarters of the total volatile matter driven off at temperatures up to 450°, if isolated before it has been subjected to the further action of heat, is found to consist chiefly of products which condense to liquids at the ordinary temperature, and only the smaller proportion consists of permanent gases—that formed in largest quantity being methane, and hydrogen being only present in relatively small amount. In addition to methane, considerable amounts of ethylene (C_2H_4) and ethane (C_2H_6), and smaller amounts of acetylene (C_2H_2), as well as of carbonic acid and carbonic oxide, are present. The presence of ethane is especially

characteristic of gases produced by thermal decomposition at low temperatures; this being one of the first to disappear when gases containing it are subjected to higher temperatures.

Although the gas obtained under these conditions is of high calorific and illuminating power, its amount is so small that the yield of heat units from a ton of coal is very low; and where the object is to obtain a high yield of heat units per ton in the form of a combustible gas, the use of such temperatures is inadmissible. The condensable products, too, are then, so far as present knowledge goes, of comparatively low commercial value. A considerable amount of these consists of water derived partly from the moisture present as such in the coal, but more from the steam formed as one of the products of the decomposition of the coal substance. This water, of course, also contains ammonia derived from that formed by the decomposition of the coal. The tarry portion of the condensed liquids consists mainly of derivatives of hydrocarbons rich in hydrogen, and contains but small quantities of the derivatives of the aromatic hydrocarbons, poorer in hydrogen, which are of greater value.

To increase the yield of gas, and alter the character of the tarry products, the coal is subjected in its distillation to much higher temperatures, whereby further changes take place both in the non-volatile residue and in the primary products first formed as described above. The former undergoes further decomposition as the temperature rises, and especially when this has become above about 700° C. (1292° Fahr.); the volatile products from it consisting now chiefly of permanent gases and only yielding small amounts of tarry matter. The main constituents of the gas then formed are methane and hydrogen, with smaller amounts of carbonic acid and carbonic oxide, derived from the oxygen still present in the residue; and the higher the temperature of the residue, the greater is the proportion of hydrogen to methane in the gas produced. For when a mixture of these two gases is strongly heated in presence of carbon, the methane, at any specified temperature, tends to undergo decomposition into carbon and hydrogen, in accordance with the equation $CH_4 = C + 2H_2$, until the proportion of hydrogen to methane assumes a certain constant ratio, and with increasing temperature the ratio of hydrogen to methane when equilibrium has been attained regularly increases. Therefore in the case of the gases obtained by the destructive distillation of carbonaceous matter, the finding of a high proportion of hydrogen to methane in the gas indicates that in their production these gases have been subjected to a high temperature in presence of strongly heated carbon.

The further action of heat on the primary volatile products evolved at temperatures below 450° C. (842° Fahr.), whether these vapours are acted on alone or in presence of heated carbon, results in much further decomposition yielding large additional volumes of permanent gas, consisting of hydrogen, methane, ethylene, and also of benzene vapour, while the steam in presence of incandescent carbon is partially converted into water gas. Along with the permanent gas, new products, liquid at the ordinary temperature, are produced containing less hydrogen than the corresponding liquid substances obtained by low temperature carbonization; these compounds being mainly derivatives of the aromatic series of hydrocarbons. If the arrangements are such that these are heated to a very high temperature before escaping from the retort, they yield a further amount of gas, consisting mainly of hydrogen; but the other products formed from them contain very little hydrogen, and are mostly infusible and insoluble in the remaining tar. They cause great trouble in working, and render the resulting tar of considerably less commercial value.

From this short, and naturally incomplete, summary of the main stages of carbonization, two points stand out. First, that in order to obtain the maximum volume of combustible gas from the coal, the residual coke must be heated to very high temperature, as otherwise some of the volatile combustible matter remains in the coke. Secondly, that the primary volatile products produced from the coal in the early stages at low temperatures, must be subsequently exposed to the action of heat to a further extent, in order to obtain from them a further yield of permanently gaseous products, but that in this case there is an economical limit to which this heating can be carried on, as too great exposure to heat has detrimental results.

The extent to which such decomposition takes place depends in part on the temperature to which the retort is heated, and also to an even greater extent on the way in which these primary volatile products travel from the point of their formation until they reach the retort outlet and become rapidly cooled. The manner of this travel, which depends on the method of carbonization adopted, differs in some important respects in the various systems in use at the present time. It is to a more detailed study of the evidence available as to flow of the hot gases in horizontal and vertical retorts, and to the effect of variations in this manner of flow, to which I ask your especial attention to-day.

The nature and extent of the decomposition which compound gases and vapours undergo under the influence of heat depends upon numerous factors, of which the following are of primary importance: (1) The temperature to which they are heated. (2) The length of time for which they are exposed to this temperature. (3) The nature and extent of the solid surfaces with which they are in contact.

In the case of the compound gases and vapours with which we are concerned in carbonization—viz., compounds of carbon and hydrogen, some containing oxygen, nitrogen, or sulphur in addition, although the decomposition by heat takes place in what seems a short space of time when expressed in ordinary terms of seconds—it must be remembered that by comparison with the rate at which many chemical combinations occur, such as the combination of hydrogen and oxygen, these thermal decompositions must be regarded for the most part as a very slow process; and increasing the time to which these vapours are exposed to a lower temperature may have a greater effect than a shorter exposure to a much higher temperature. Further (as you know from the work of Mr. Young, largely contained in papers read before this Association), great differences in the effect of temperature occur according to the manner in which the heat is communicated to the vapours or gases, which may take place in two ways—viz., either by the gases coming in contact with the hot surface of the retort wall or of the incandescent coke, or, where the gases are passing through a space and are not in contact with solids, they may also be heated by the heat-rays radiated across this space. In the first case, the temperature of all the constituent gases and vapours tends to rise fairly quickly to that of the surface with which they are in contact; but where the gas is passing through a heated free space, considerable difference occurs in the action on the various constituents of the gaseous mixture, inasmuch as the molecules of more complex vapours have a greater absorptive capacity for radiant heat than those of the simpler gases; and owing to the more rapid absorption of heat by the molecules of the former, many of them probably attain a much higher temperature locally than the average temperature of the gas as a whole. In consequence, when subjected to the action of radiant heat, the tendency is for the more complex bodies to be broken up much more rapidly than the more stable gases, such as methane.

With reference to the nature of the solid surface, in ordinary carbonization we have only to do with the surface of the incandescent coke, and to a smaller extent with that of the fire-clay walls of the retort. There is no very definite evidence of any specific action of the latter. In practice, this always becomes largely coated with a deposit of carbon; and so far as is known at present, no great error is made in assuming that the whole of the solid surface with which the hot gases come in contact consists of carbon having a varying degree of purity.

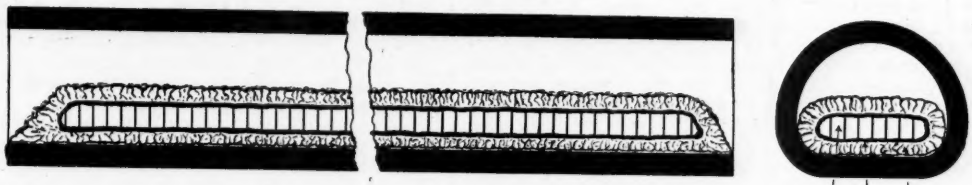
Let us now examine more in detail what happens to a large mass of coal, when subjected to a high temperature in a closed retort, taking first the form of retort almost universally adopted until recent years—viz., the horizontal retort. In this discussion, I am considering only the case of caking bituminous coal, such as is used in the great majority of cases for gas making, which on heating first goes to a semi-fused mass before undergoing any considerable amount of decomposition. But I would point out that where non-caking coals are used, modifications may occur in important respects with respect to the action of the heat.

When the retort is charged, the heat must penetrate the cold mass of coal from the periphery inwards, the external portion becoming heated first. The outer layers, therefore, become first heated, and as their temperature rises, some of the coal constituents melt, and we get a pasty layer surrounding the interior portion of unaltered coal which is at much lower temperature. As the temperature increases, this plastic layer decomposes and gives off much of its volatile matter; and by the time some three-fourths of this has been evolved, it is converted into a solid porous mass of low temperature coke, still containing a good deal of volatile matter. In the meantime, the heat has penetrated further into the coal mass, and below the layer of solid porous coke we have another which has reached the plastic condition, and within that a core of uncarbonized coal, only slightly raised in temperature and only undergoing slight decomposition, mainly consisting in the evolution of steam. Figs. 1 and 2 will show diagrammatically what is probably the state of things at this stage. The uncarbonized core of coal is represented by horizontal or vertical cross hatching, the pasty layer by a thick black line, and the outer layer of a more or less completely coked material is represented as a cracked and fissured mass.

This plastic mass has two important properties. In the first place, when in this condition the coal is hardly permeable to gases; and in the second it is a very bad conductor of heat. When, therefore, carbonization has proceeded to a certain extent, a layer of hot partially coked coal has formed in a solid condition on the outside of the mass; and between this and the uncarbonized coal there is a more or less complete layer of pasty coal, the continuity and thickness of which will vary according to the nature of the coal and to the rate at which the heat is penetrating the mass. On the outside of this layer, it is in contact with the hot coke, and on the inside with the relatively cool uncarbonized coal. Where this poorly conducting layer is of any thickness, its temperature must be much higher on the side in contact with the hot coke; and it must be on this side that the main decomposition and evolution of the volatile gases and vapours is taking place. The gases evolved at this point consist, when first formed, of the low-temperature products already referred to—viz., a small amount of rich gas (the constituent gas present in largest quantity being methane) and condensable liquid carbon compounds relatively rich in hydrogen, and belonging to those series in which the carbon atoms are united together in open chains, or, if present as closed chains, are combined with much more hydrogen than is the case with the aromatic hydrocarbons, as in the naphthenes and similar compounds, and contain but small amounts of the aromatic derivatives characterized by

HORIZONTAL RETORTS.

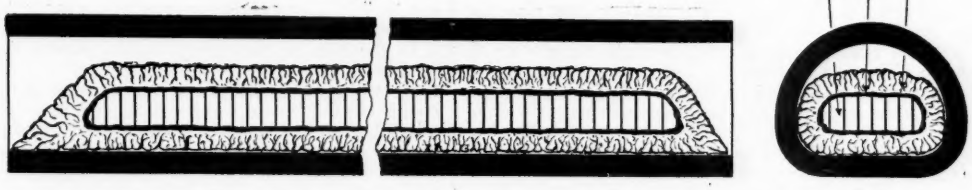
Fig. 1.



LIGHT CHARGE, CARBONIZATION HALF COMPLETED.

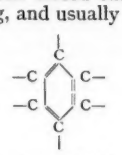
A. UNALTERED COAL
B. PASTY LAYER
C. COKE

Fig. 2.



HEAVY CHARGE. CARBONIZATION HALF COMPLETED.

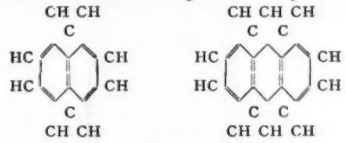
containing the characteristic closed chain of six carbon atoms, known as the benzene ring, and usually written as



this chain being capable of combining with no more than six atoms of hydrogen without losing its especial characteristics.

Under the retort conditions above described, however, it is evident that before they can escape from such a horizontal retort, these gases and vapours, after their first formation, must be subjected to the further action of heat; for in order to find their way to the retort outlet, they must pass first through the hot layer of coke on the outside of the mass, and then, unless the retort is completely filled with coal, through the free space above the coal, where they are subjected to the heat radiated from the retort walls.

In their passage through the hot coke, the permanent gases methane, ethane, ethylene, and acetylene, all tend to undergo change. The methane is the most stable, and, as has been shown by Professor Bone, is not much affected below temperatures of 800° C., and even then the rate of its decomposition is largely dependent on the extent of the heated surface to which it is exposed. But the ethylene, and especially the ethane and acetylene undergo decomposition at lower temperatures, the latter in particular also undergoing condensation, forming benzene and other aromatic hydrocarbons. The tar vapours also undergo further decomposition, yielding additional considerable amounts of permanent gas, especially of hydrogen, together with methane with some ethylene, and at the same time yield condensable vapours differing from the primary tar vapours, in containing a much smaller proportion of hydrogen, and consisting of derivatives of benzene, containing the characteristic nucleus of six carbon atoms. These themselves, if subjected to higher temperatures, undergo still further changes, yielding a gas that is mainly composed of hydrogen, together with vapours of hydrocarbon derivatives, containing still less hydrogen, such as naphthalene and anthracene, containing condensed benzene nuclei of carbon atoms represented by the formulæ,



With still higher temperatures, and with increase of time to which the vapours are exposed to those temperatures, these last yield hydrogen and still more complex condensed benzene nuclei, leading eventually to carbon itself if the heat is sufficient; the molecule of solid carbon consisting in all probability of a very large number of carbon atoms arranged as a honeycomb of condensed benzene nuclei. The above complex substances containing many benzene nuclei, but also still some hydrogen, &c., are for the most part black infusible substances, and form what is generally spoken of as the "free carbon" found in the tar, though strictly speaking they are compound substances containing hydrogen and oxygen, as well as carbon, but in their physical properties they are almost identical with carbon itself. Their formation is in any case most undesirable, as the slightly increased production of hydrogen during their formation is far more than counterbalanced by their action in causing stopped pipes, &c., and diminishing the value of the tar and of the pitch produced from it.

The steam also formed in the primary decomposition of the coal must likewise pass through the heated coke layer, and thus partially combines with the carbon of the coke yielding water gas; so further increasing the yield of combustible gas. This action has also the further effect that the other gases and vapours are more diluted with the stable gases, hydrogen and carbonic oxide, which dilution protects them to some extent from decomposition, and also causes them to remain for a shorter time in contact with the hot coke.

It is evident that, as carbonization proceeds, the vapours must find their way through a layer of coke which is constantly increasing in thickness and in temperature, and in consequence the "cracking" of the primary vapours and gases increases in extent as carbonization proceeds, with the result that in the permanent gas produced there is a steady decrease in the proportion of the hydrocarbon gases produced, and a corresponding increase in the proportion of hydrogen. The evidence available, however, points to the conclusion that the extent of the decomposition by this travel through the hot coke is not under ordinary conditions such that any considerable amount of the substances termed free carbon are formed. But after traversing the coke, the gases and vapours before reaching the mouthpiece must pass to a greater or less extent along the heated free space above the coal. Here the amount of heated surface is relatively small, and the chief action is that of the radiant heat, which, as shown by Mr. Young, has a much smaller action on the simpler permanent gases than on the complex molecules of the vapours, so that the methane is comparatively unaffected. But it is here that, if the temperature of the retort walls is very high, the greatest production of naphthalene, and especially of free carbon, occurs.

Let us now consider what happens in a horizontal retort charged with coal to such an extent as to leave a free space of about half the retort capacity above the coal, as was the general practice until recent years. With such a small charge, while the changes in general must be such as described above, the heat penetrates into the centre of the charge fairly rapidly, and the amount of coal in the pasty condition will probably not be of any considerable thickness; and with coal such as is mostly used for gas making, consisting of mixed lumps and small, this layer will be nothing like as defined as that shown in the accompanying diagram (fig. 1). The average amount of coke surface through which the vapours have to pass, more especially in the later stages, will be less than with a heavier charge, and the decomposition of the gases and vapours from this cause should not be excessive under these conditions. But with such a large volume of free space over the coal, the average time occupied by the gases in traversing this heated space must be considerable. Under the old conditions when light units were chiefly desired, and retort temperatures were maintained at something like 900° C. (1652° Fahr.), these conditions were most favourable for the production of the maximum amount of gas of high illuminating power, as a fairly long heating of the gas in the free space at such low temperature was required to obtain as much rich gas as possible from the primary tar vapours. At the same time, the heating in the free space at this temperature was not sufficient to produce undue amounts of naphthalene, &c., and free carbon. With a low retort temperature, too big a charge, and consequent reduction of the free space, would have resulted in too little gas production and the presence of much paraffin constituents in the tar. One result of these low temperatures was, however, that a good deal of volatile matter, capable of yielding a considerable amount of gas of fair heating power, though of little illuminating power, was left in the coke. When, on the other hand, the attempt is made to obtain this residual volatile matter in the form of gas by increasing the temperature of the retort, and therefore also the final temperature of the residual coke, the temperature of the free space is also inevitably raised, whereby the "cracking" of the vapours is greatly increased. The production of naphthalene and "free carbon" is also much accentuated; while the yield of naphthalene

solvents is diminished, and causes great trouble in the manner I need not enlarge on to this audience.

When using high temperatures to get the volatile matter driven off from the coke as completely as possible, these deleterious results may be much modified by increasing the weight of charge, and thus diminishing the amount of free space above the coal. With the larger charge, the rate at which the heat penetrates to the centre is decidedly slower, and the thickness of the pasty layer under these conditions is probably greater. [This thickness of the pasty layer has also an important influence on the quality of the resulting coke, but time will only permit a bare reference to this point.] With such heavier charges, the primary volatile products, especially those produced in the later periods, have an increased travel over hot coke; but, on the other hand, owing to the greatly reduced volume of the free space, the *time* during which the gases and vapours are exposed to the radiant heat in passing through it is proportionately reduced. The latter factor is much more potent than the temperature of the retort walls radiating heat through the free space, and the deleterious excessive formation of naphthalene, &c., is greatly minimized in spite of the high temperature of the retort walls. For this advantage a price has, however, to be paid. As the tar is less heated in the free space, it retains a higher proportion of hydrogen and carries with it matter which, with the lighter charge, is converted into methane and hydrogen, and helps to swell the yield of gas. At the same time, when the size of the charge is above a certain weight (varying with different coals), the output obtainable from a given bench of retorts falls off to some extent.

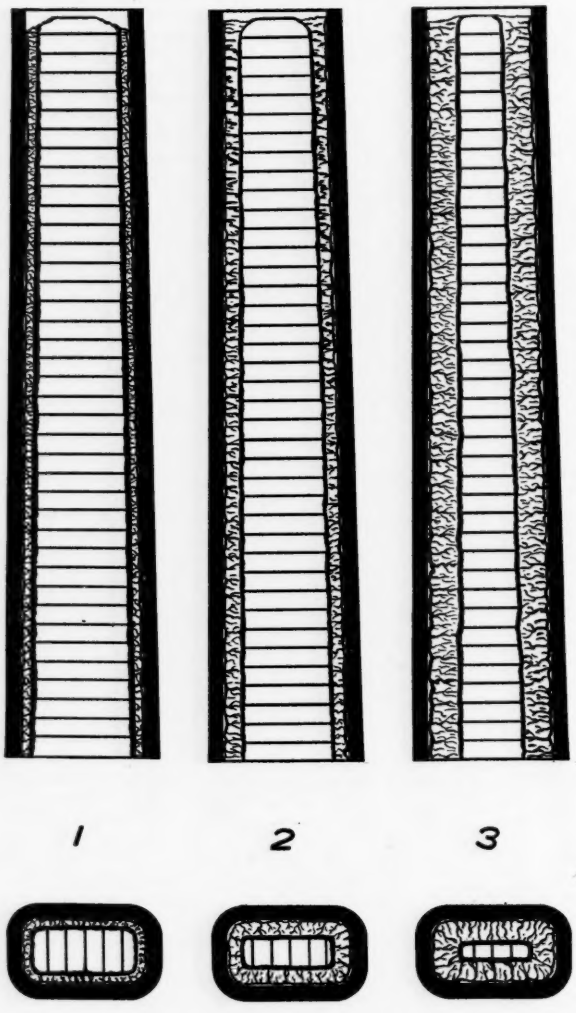
Before leaving this matter one point should be mentioned. In the Cantor Lectures recently given by Professor Lewes, the latter suggests that the avoidance of over-cracking when a retort is more fully charged is due, not so much to the decreased size of the free space, but more to the fact that the gas produced can travel through the interior core of uncarbonized coal to the ends near the mouthpiece, and, then passing through the coke layer at this end, reach the ascension-pipe without traversing the free space at all. It seems to me, however, that this cannot take place to any considerable extent, as, for the reasons given above, the chief production of gas must take place on the outer side of the pasty layer where it is in contact with the heated coke, in which case it would have great difficulty in penetrating through to the inner side of this layer and then travelling as suggested by Professor Lewes, but would rather take the easier path through the fissures of the coke around it into the free space.

Let us now consider the conditions prevailing in vertical retorts, where the charge fills the retort, and the heated free space above the coal is *nil* or very limited. First, with the intermittently charged retorts, the heat, just as with horizontal retorts, must penetrate the mass from the periphery inwards; and as in the latter retorts, after carbonization has proceeded for some time, we get a layer of solid coke on the outside, then a pasty layer, and then the core of uncarbonized coal. As the heat penetrates further, this pasty layer is coked, and a fresh one forms on the inner side, as represented in the diagram in fig. 3, showing the presumed condition of affairs at different periods as carbonization of the coal progresses.

In the case of continuous vertical retorts, the conditions are modified. Here also the heat penetrates the mass of coal from the periphery inwards, but at the same time the whole mass of coal is steadily moving downwards, so that the uncarbonized coal takes the form of a wedge, the point of which in normal working is some two-thirds of the way down the retort. Surrounding this wedge, and between it and the coke, is again the pasty layer; the conditions of affairs being represented diagrammatically in fig. 4. With continuous retorts, this condition of things remains approximately constant all the time.

By the kind permission of Mr. John Bond, of Southport, I am able to show you to-day (fig. 5) a diagram exhibiting the temperatures in the mass in the Glover-West continuous vertical retort. The temperatures shown on the curve AA are those observed by means of a thermo-couple in the centre of the retort, along the line also marked AA in the vertical section of the retort on the right-hand side of the diagram; and the curve BB shows the temperatures just about an inch from the retort-wall. The temperatures

INTERMITTENT VERTICAL RETORT.

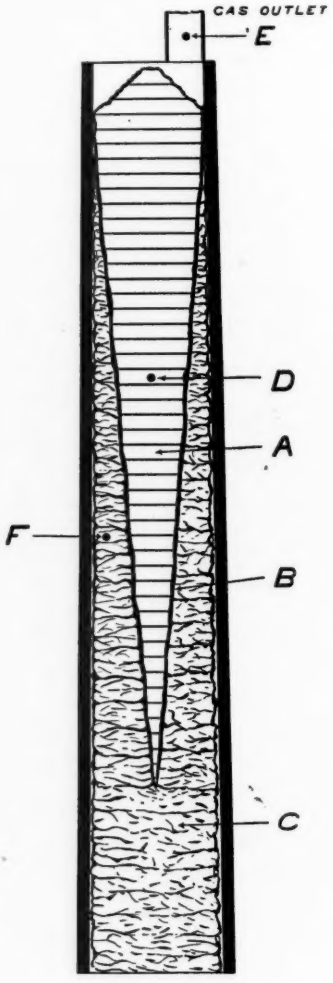


A. Unaltered coal, B. Pasty layer. C. Coke.

STAGES OF CARBONIZATION.

Fig. 3.

CONTINUOUS VERTICAL RETORT.



A. Unaltered coal.
B. Pasty layer.
C. Coke.

Fig. 4.

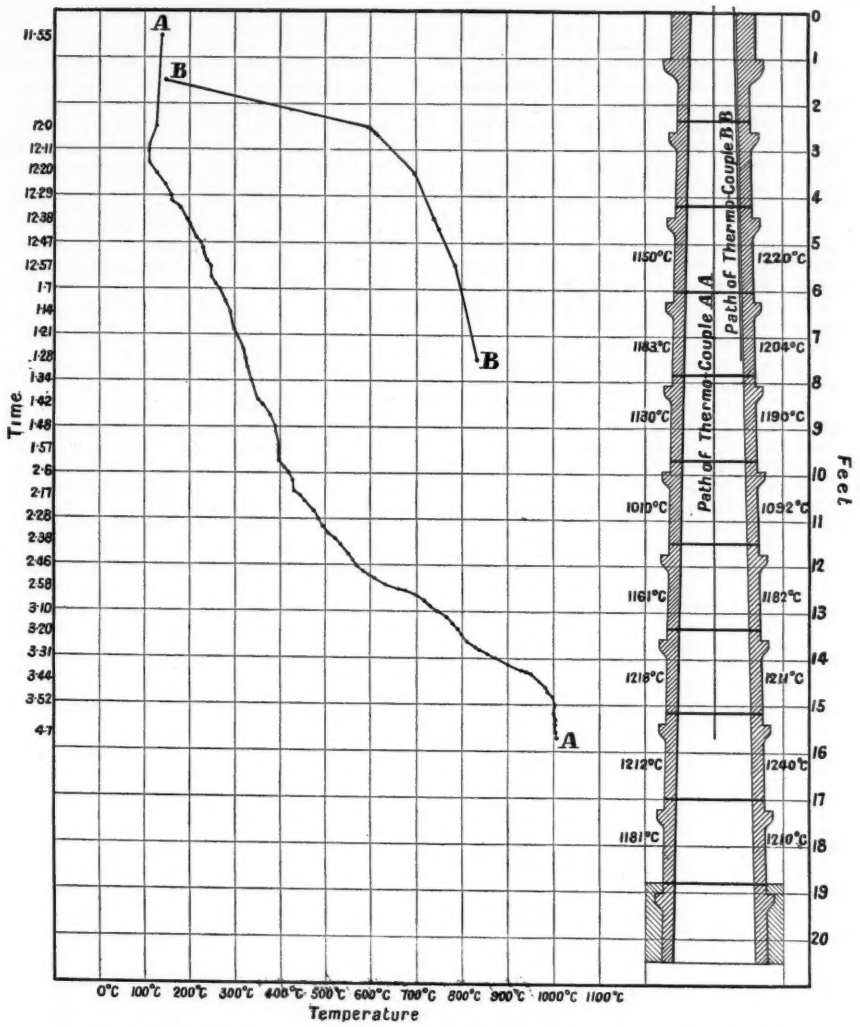


Fig. 5.—Diagram showing the Temperatures in a Glover-West Continuous Vertical Retort.

shown outside the retort in the various combustion chambers were taken by a Féry mirror pyrometer.

Now, whereas in horizontal retorts, when once a layer of hot coke has been formed on the outside of the coal mass, the primary volatile products must find their way out through this hot coke at some point or other, no other path being available, there are in all fully-charged vertical retorts two paths possible by which these products can get to the gas-outlet at the top of the retort. These ways are, on the one hand, through the hot coke layer, and, on the other, through the relatively cool core of uncarbonized coal; and, as you know, Dr. Bueb has promulgated the view that in his intermittent vertical retorts these products take the latter path. This hypothesis looks at first sight very attractive, as it affords a ready explanation of the fact that the tar produced in these retorts has evidently not been subjected to cracking to anything like the extent which occurs in highly-heated horizontal retorts; and originally I regarded this hypothesis as correct, as also I find did Mr. Young. Further experience, however, has convinced me that where caking coals are used, the hypothesis is only true to a very limited extent, though with non-caking coals and material such as shale, which do not pass through a plastic stage on heating, it is very likely largely true.

If the primary volatile products formed up to about 500° C. passed inwards and upwards in the manner required by Dr. Bueb's hypothesis, it would follow that from the time of their formation they would consistently travel in a direction which would ensure that they were steadily subjected to a constantly decreasing temperature. In this case the resulting gas would show to some extent at least the characteristics of a gas produced at low temperature, masked in part by the gas produced in the later stages from the remaining volatile matter in the coke by the final action of the high temperatures employed; while the tar produced would be a low temperature tar, and would closely resemble "coalite" tar, containing but a small amount of aromatic substances. In point of fact, the gas produced has all the characteristics of a gas which has been subjected to high temperatures; the proportion of hydrogen to methane being high, higher indeed than in that obtained from the same coal in highly-heated horizontal retorts. The amount of ethylene is low; and in no case have I been able to detect in the gas from these retorts the presence of any appreciable amount of ethene, which is usually present in gases produced by carbonization at low temperatures. The tar produced from these retorts, again, although it contains more paraffin derivatives than tar from horizontal retorts, consists chiefly of aromatic substances, and in its formation the vapours produced at low temperatures must have been subjected to a considerably higher temperature before escaping from the retort.

The pressures prevailing in the retort also point to the conclusion that the gas does not mainly travel up the core of cool uncarbonized coal. At the commencement of carbonization, the area available for the gas to travel up this core is greatest, and it diminishes as carbonization proceeds; and as the volume of gas produced does not vary greatly during the first seven hours, one would expect, on the hypothesis of the inward and upward travel, that the gas-pressure at the bottom of the retort would be low at first, and would then steadily increase as the size of the uncarbonized core diminished. In fact, however, the pressure at this point is very high at the commencement, often exceeding 6 inches, but steadily falls to a few tenths long before the make of gas drops materially. This, on the other hand, is just what would be expected, if the gas travels mainly through the coke layer. At the commencement there is none, and the gas produced has to find a difficult path through the mixed lumps and small of the coal. But after a solid coke layer has been once formed, this affords an easier path; and as its extent increases and its temperature rises, this coke layer—however much it may have expanded during the plastic stage—then undergoes contraction from the further loss of volatile matter, and in contracting develops cracks and fissures, which afford a constantly increasing area for the passage of the gases being produced on the outside of the pasty layer, so that the pressure required to force the gas through the coke should steadily decrease, as in fact it does.

There are a number of other facts affording evidence pointing in the same direction; but time will not permit of further consideration of them here. Taken all together, they have convinced me that in fact the great bulk of the gas is produced on the outer side of the pasty layer, and that this mainly travels onwards through the hot coke, mixing with the poorer gas produced by the further action of heat on the low temperature coke first produced. What little gas is produced on the inner and cooler side of the pasty layer will pass up through the coal; and it seems most probable that the vapours which pass in this direction form the paraffin constituents of the tar, which are undesir-

able. Therefore if the above contentions are correct, in so far as this inward and upward travel does take place, it is disadvantageous rather than advantageous. At the same time, I do not regard it as probable that the pasty layer forms an absolute barrier for the passage of the gas from one side of it to the other; for where the coal charged is broken coal containing both lumps and small, this layer would not in all probability be as uniform and complete as indicated in the diagrams, but there would be holes in it in various places, and some gas would pass from one side to the other. In the main, however, I think the gases produced on either side would remain separate until they joined at the top of the retort.

In the continuous vertical retorts I believe that the conditions are much the same. The bulk of the volatile matter is driven off on the outer side of the pasty layer surrounding the internal wedge of uncarbonized coal, and only a small amount of gas produced on the inner side passes upwards through the coal.

I had intended to carry out further experimental work on the subject before entering into a discussion of this subject; but as I have had to prepare the lecture at short notice, time has not allowed of my doing much in this respect. I have, however, been able to collect and analyze samples of the gas from different parts of the continuous vertical retorts; and the results so far as they go confirm the conclusions given above. If the gases travelled inwards and upwards through the coal, it would be expected that the gas taken from the latter would be very close in composition to the mixture passing away from the top of the retort, while the gas collected from that passing through the coke would be of very different composition, and contain little, if any, unsaturated hydrocarbons; whereas if the bulk of the gas travels mainly through the coke, one would expect the gas taken from the coal to be much richer than the mixture at the top of the retort. The gas taken from the coke would contain considerable amounts of unsaturated hydrocarbons, although if taken some way down from the top of the continuously working retort (where the greater proportion of the richer gas must be produced), this would not be so rich a gas as the average of the gas passing from the retort.

Samples of the gas were, therefore, collected by aspirating through a tube from the point D (in fig. 4) in the centre of the coal core, 7 feet from the top of the retort, from the point E in the gas outlet pipe, and from the point F in the coke, about 4 inches from the side of the retort and 10 ft. 6 in. from the top. On analysis, it gave the following results:

	D. From Coal.	E. From Outlet Pipe.	F. From Coke.
Carbonic acid	5·9	3·2	3·0
Unsaturated hydrocarbons	2·0	2·3	1·9
Oxygen	*nil*	*nil*	*nil*
Carbonic oxide	8·8	11·9	12·9
Methane	37·2	28·0	20·2
Hydrogen	45·3	53·5	59·0
Nitrogen	0·6	1 3	3·2
	99·8	100·2	100·2

These results, therefore, so far as they go, indicate that the main travel of the gas is through the coke and not through the coal. They give, however, only the percentage composition of the gas, and do not allow any direct estimation of the relative volumes of the gas passing through the coal and coke. But it was observed, in taking the samples, that the great bulk of the hot gas aspirated from the point D consisted of *steam*. In the average gas from the outlet pipe at E the proportion of permanent gas to steam was about 100 volumes to 30 volumes. Quantitative measurements of the amount of steam in the gas A collected from the coal have not yet been carried out; but to all appearance the proportion of permanent gas to steam in this sample is not more than 100 to 400, and in that case the total amount of gas passing through the coal must be very small. As opportunity occurs, I hope to be able to make further tests in respect to this point.

If the above conclusions are well founded, it follows that in fully-charged vertical retorts, the volatile products are on the whole subjected to the action of the heated coke to a rather greater extent than is the case with horizontal retorts. The hot coke surface in the time during which the gas is in contact with it, effects a rather increased decomposition of the simple hydrocarbon gases, into carbon which remains on the coke, and hydrogen which passes away with the gas; and as a result the gas produced contains less methane and ethylene than is given by the same coal in horizontal retorts under the best conditions. So far as heat units are concerned, this loss of carbon from the gas is largely compensated for by the more complete elimination of the volatile matter from the coke in the case of the vertical retorts. The tar vapours, on the other hand, although for the most part they also pass over the hot coke surface, are much less rapidly decomposed than the simpler gases under these conditions. In spite of this passage, and as the gases and vapours are not, with a full retort, further subjected for any length of time to the action of radiant heat in a highly heated free space, which especially affects the complex vapours and has only a small effect on methane, no additional decompositions take place as in the horizontal retorts, so that the resulting tar has not an undue proportion of naphthalene or free carbon, nor a deficiency of naphthalene solvents. But this advantage of an improved tar, with its resulting facilitation of retort-house work and disappearance of the naphthalene trouble, is accompanied by a certain disadvantage—namely, that the extra cracking of the tar vapours taking place in horizontal retorts, though so disadvantageous in many ways, does result in the production of additional gas—mainly hydrogen, methane, and ethylene—which with the vertical retorts remains in the tar.

These considerations indicate at least two directions in which it is possible to still further improve the results obtainable with vertical retorts. In the first place, as matters are at present some of the valuable methane produced is partly broken up into carbon, which remains behind with the coke to the detriment of the heat units in the resulting gas. If this can be prevented or minimized, while still enabling the volatile matter to be completely driven off from the coal, even better results will be obtained. Secondly, with the present arrangements in vertical retorts the condensed tar carries away with it matter which is capable of yielding gas; and it would be possible, by subjecting the tar vapours to a further regulated period of cracking at moderate temperatures, to obtain from these a further amount of gas containing methane and ethylene as well as hydrogen, at the same time converting into aromatic derivatives, the undesirable paraffin constituents still left, without production of an undue amount of naphthalene and free carbon.

It is a very easy matter indeed to point out these desirable ends; but the great difficulty lies in bringing them about by means which are practicable and economical. The problem is one of great complexity; for improvements made in one direction generally result in disadvantages in other directions. It seems to me, however, that the requirements here mentioned are likely to be most readily achieved with a continuous process of carbonization; for in such a process, the volume and composition of the gases and vapours being produced remain always approximately constant, and there is then a much better chance of arranging the conditions to bring about the desired ends. With any intermittent process, the problem has additional difficulties, as the volume and composition of the gases and vapours formed varies considerably, so that conditions which at one stage may be favourable become unfavourable at another.

We all of us recognize the great improvements which have been effected in the process of carbonization during the past decade, not only in the development of vertical retorts and the rendering practicable a continuous method of carbonization, but also in the practice of carbonization in larger bulk, whether in coke-ovens or for gas-making purposes, and in the way of greatly improved working with the older horizontal retorts. We recognize gratefully the valuable work done, not only by him whose memory we honour to-day, but by many others in this and other countries whose names are household words; nor should we forget many pioneer workers who have done valuable work, but whose labours, as is so often the case, have received no reward other than the virtue of their work. But while much has been accomplished, we realize equally that much still remains to be done, and that we have an immense deal to learn (and also to unlearn) with regard to carbonization. Time to-day has only permitted of the consideration of one or two matters, but many other points will be in the minds of you all—such, for example, as the improvement in the quality of the coke produced, and increasing the proportion of the nitrogen in the coal obtained in the form of ammonia, as well as better and more economical means of carrying out the various processes; and I feel that in no way can we better honour the memory of William Young than by each one of us, in his own way, endeavouring to the best of our ability to go forward with the work so long and so ably carried out by him.

It was announced at the monthly meeting of the Fylde Water Board last Wednesday that, in recognition of the extra services rendered by Mr. J. Cook, the Engineer to the Board, in connection with the Higher Hodder scheme and the passing of the Board's Bill, he had been granted an honorarium of £500, and that his salary had been advanced by £200 per annum. For similar reasons, Mr. C. Arthur, the Secretary to the Board, had £100 voted to him and his salary increased by £50 per annum.

Discoursing last Friday evening on the subject of "Radiators Old and New," at the meeting of the British Association in Dundee, Professor W. H. Bragg, F.R.S., Professor of Mathematics and Physics in the University of Leeds, dealt with the theories of light held by Newton and Huygens in relation to the modern knowledge of the subject. He said that though the corpuscular and wave theories of light, for which these inquirers respectively stood, represented two totally different schools of thought, it was not impossible that modern research would once more draw the two theories together. The new radiations with which people had become familiar since the rays from radio-active substances had been inquired into involved the idea of material streams moving with velocities of the order of light; and the reasons which Huygens gave for the abandonment of the corpuscular and the adoption of the pulse or wave theory, were therefore mistaken. The question was whether in the new rays of radio-active substances they had found the actual corpuscles which Newton imagined. Much time and labour were now being spent in the attempt to verify or to disprove their parallelism with the rays of light; and if verification was found, there would be strong reasons for supposing that Newton's corpuscular theory of light was partially correct in form. While, however, they felt that they might have been hasty in neglecting altogether the form and the ideas of the corpuscular theory, they must somehow contrive to retain the positions which the wave theory had won for them.

GASEOUS EXPLOSIONS.

Fifth Report of the British Association Committee.

Before Section G, at Thursday's session of the meeting of the British Association, which was held in Dundee last week, the Committee appointed for the investigation of gaseous explosions, with more especial reference to temperatures, presented their fifth report.

The members of the Committee are Sir William H. Preece (Chairman), Dr. Dugald Clerk and Professor Bertram Hopkinson (Joint Secretaries), Professors Bone, Burstall, Callendar, Coker, Dalby, and Dixon, Dr. Glazebrook, Professors Petavel, Smithells, and Watson, Dr. Harker, Lieut.-Colonel Holden, Captain Sankey, Mr. D. L. Chapman, and Mr. H. E. Wimperis. The first report was given in the "JOURNAL," Vol. CIII., pp. 719, 793; the second, in Vol. CVII., pp. 766, 834; and the third, in Vol. CXI., p. 640. The fourth report was merely a *pro formâ* one, and was referred to last year, p. 675 of the "JOURNAL" for Sept. 12. The fifth report is as follows:—

INTRODUCTION.

Five meetings of the Committee have been held—one at the Central Technical College, when Professors Callendar and Dalby were good enough to show the members of the Committee the apparatus used in their experiments on gas-engines, and four (by the kindness of Dr. Dugald Clerk) at No. 57-58, Lincoln's Inn Fields. In accordance with their previous practice, notes dealing with their current work have been presented for discussion by members of the Committee, as follows:—

No. 21.—Measurements of Turbulence caused by Suction in the Gas-Engine (B. Hopkinson).
No. 22.—Rate of Flow of Air through a Round Orifice (W. Watson).
No. 23.—Experiments on Some Conditions which cause great Variation in the Rate of Inflammation within the Gas-Engine Cylinder (Dugald Clerk).
No. 24.—Effect of Turbulence on Heat Flow (Dugald Clerk).
No. 25.—The Effect of Turbulence on Rate of Ignition and of Heat Loss (B. Hopkinson).
No. 26.—The Flow of Heat from a Charge of Air subject to Cyclical Variations of State in the Cylinder of a Gas-Engine, and the Comparison of the Temperature Readings of a Platinum Thermometer with the Temperature computed from the Pressure-volume Diagram (W. E. Dalby).

During the session 1911-12, the experimental work by members of the Committee has been continued, and some of it has been brought to a conclusion. Much of this work has consisted of measurements of radiation and of turbulence in a gaseous explosion, and Mr. W. T. David, a pupil of Professor Hopkinson, has published an important paper in the "Philosophical Transactions of the Royal Society" dealing with the first of these matters. The rest of this work has not yet been published; but an abstract of the results obtained is given in the body of this report. Professor Dalby has continued his measurements of the suction temperature in gas-engines, and of the gas temperature reached in compressing and expanding air. Professor Watson has read a paper on the measurement of air-flow by means of an orifice, the results of which make available for use an accurate and simple method of measuring the supply of air to a gas-engine, and will, therefore, be of great value to those engaged in experimental work on such engines.

In this report, the Committee propose to give a short review of the present state of knowledge with regard to the heat-flow from the working substance of a gas-engine into the cylinder walls. It is unnecessary to insist on the importance to practical designers of this side of the theory of internal combustion engines. It is now fully recognized that a great part of the difficulties experienced in the construction and working of these engines is ultimately due to heat-flow; and the subject has been brought into special prominence in recent years by the introduction of large cylinders in which these difficulties have only partially been overcome.

The rate of flow of heat from the gas to any part of the walls at each instant of time depends upon the then state of the gas as regards temperature, density, and motion, and also on the temperature and condition of the wall surface. It differs widely at different points of the expansion stroke; being far greater just after firing, when the gas is at a high temperature and highly-compressed, than towards the end of expansion. There will, however, be a certain mean rate of heat-flow into any patch of the cylinder walls, and heat must be conducted from that patch on the whole as fast as it goes in. In order that the heat may be conducted away at the required rate, there must be a certain temperature gradient in the metal, and there will be a corresponding mean surface temperature. Superposed on the mean surface temperature are variations due to the varying rate of heat-flow at different parts of the cycle. The thermal conductivity and capacity for heat of cast-iron are, however, so large that these variations on a clean metal surface must be small—a conclusion which has been verified by Coker, who found a maximum cyclical change of but 7° C. at a depth of 0·015 inch in the wall of the combustion chamber of an engine running at 240 revolutions a minute. If the metal surface is not clean, the variation at the surface of the carbon or other deposit may be much greater.

The important practical question is the mean rate at which heat goes into each part of the surface, and the resulting mean distribution of temperature. The chief problem in designing large gas-engines is to control the mean temperature distribution, by water-jacketing or otherwise, in such a way that the metal does not get overstrained by unequal expansion nor reach a temperature sufficient to ignite the gas. The temperature gradient necessary to sustain the flow of heat from the inside of a combustion chamber to the external water is not likely to exceed 50° C. per inch. At places where the metal is not thick, and effective external circulation of water is possible, cooling does not present great difficulty; but at places which are not near to the cooling water, so that the heat has to travel a long way, the temperature must be high to give the necessary gradient. Thus the central portion of the head of an ordinary flat-faced piston if not water-cooled gets very hot, reaching a temperature of perhaps 600° C. in a four-cycle engine of 24 inches bore. The piston expands considerably in consequence; the expansion being greater at the centre than at the edge, which is accordingly put into tension. In larger cylinders the stresses in the piston set up by unequal heating, as also the danger of pre-ignition arising from the hot metal, necessitates the cooling of this part by the circulation of oil or water. Even then the great thickness of metal in certain portions of the combustion chamber, and the difficulty of keeping the water flowing properly in every corner, may cause high local temperatures.

The heat carried away by the cooling water and by radiation is the total given to every part of the walls, and its measurement gives no information on the important question of the manner in which the flow is distributed over the walls. It is certain, however, that the greater part of the heat-flow in a cycle occurs in a comparatively short time just after the moment of ignition, and passes therefore into the surface of the combustion chamber and valves and into the face of the piston. But little goes into the barrel of the cylinder, which is not uncovered until the density and temperature of the gases have fallen. That this must be so is obvious; but the magnitude of the effect is perhaps not generally recognized. Dugald Clerk found in his experiments on the compression and expansion of flame,* that the average heat-flow per square foot per second in the first three-tenths of the stroke is three times that of the average over the whole stroke for equal temperature differences; and he calculates that the actual rate of heat-flow in the first three-tenths is six times that of the whole stroke in ordinary gas-engines working at full load. This estimate, however, does not include loss due to radiation before maximum temperature. In the actual firing and expansion stroke of a gas-engine, the difference must be even more when radiation and other losses incurred before maximum temperature are included; and it is probable that in discussing the problem of cooling the metal it is a sufficiently good approximation to altogether neglect the heat-flow into the outer half of the barrel. Professor Hopkinson informs the Committee that he has worked a gas-engine cylinder, of over 30 inches diameter, in which there was no water circulation round the barrel at all The whole of the heat passing into the barrel was in this case removed either by radiation or by conduction into the piston, nor was the cooling which was applied to the piston much more than that found necessary on other parts of the walls of the combustion chamber. In small engines with uncooled pistons, the water-jacket round the barrel is necessary to keep the piston cool.

In the scientific analysis of gas-engine phenomena the facts stated in the last paragraph are important, because they show that the heat-flow is not much different from that which would occur in a closed vessel of invariable volume having the form and size of the combustion chamber; the mixture fired having, of course, the same composition, density, movements, &c., as in the engine. Some allowance must be made for the fall of temperature and density which occurs in the initial stages of the expansion in the engine; but this will be of the nature of a correction, and will not affect the value of the general conclusions as to the effect of the various factors in heat-flow which may be drawn from closed-vessel experiments.

THE FACTORS IN HEAT-FLOW.

1. *The State of the Walls.*—The loss of heat following a gaseous explosion in a confined space depends partly on the state of the gas and partly on the state of the walls of the enclosure. Dealing first with the walls, it is obvious that the higher the surface temperature the less rapid will be the flow of heat, which (generally speaking) depends on the difference of temperature between the gas and the surface. If the metal surface be clean, the surface temperature cannot rise by more than an insignificant percentage of the temperature difference; but if it be coated with a non-conducting layer, the exposed surface may be heated by the first rush of heat after ignition to such an extent as materially to check the subsequent flow. For instance, Hopkinson found that a layer of brown paper $\frac{8}{1000}$ inch thick pasted inside an explosion vessel of 1 cubic foot capacity would reduce the rate of heat-flow in the first tenth of a second following maximum pressure by more than 30 per cent.† The surface of the paper was not charred; but it must for an instant have reached a temperature of several hundred degrees Centigrade in order to produce such a result. This shows that a badly conducting deposit of carbon in a gas-engine may materially reduce heat-flow. Since the high surface tem-

* Proceedings Royal Society, Series A., Vol. LXXVII. (1906), p 500
† See "Engineering," Sept. 11, 1908, p. 328.

perature occurs just after explosion, it will not necessarily cause pre-ignition, though, of course, if the mean temperature be high, so that the surface remains red-hot throughout the cycle, it will have that effect.

2. *Radiation from the Gas.*—Of more scientific, though perhaps of less practical, interest is the reduction in heat-loss which is found when the walls are highly polished. This is due to the fact that radiation is an important, if not the principal, agent in the transfer of heat from the gas to the metal. This matter was dealt with in the third report of the Committee; and it is unnecessary to recapitulate the results there given. It has, however, been carried a good deal further by the researches of W. T. David, who has investigated the relation between the amount of the radiation and the mean temperature of the gas.* He finds that the rate of loss from this cause varies roughly as the fourth power of the absolute temperature. Thus the products of exploding a 15 per cent. mixture of coal gas and air in a cylindrical vessel 1 ft. by 1 ft. radiate about 5 gramme-calories per square centimetre per second when the absolute temperature is 2100° C. (maximum pressure); but a tenth of a second later, when the temperature has fallen to 1700° C., the radiation is only half as great.

In a closed vessel explosion, the rate of heat-flow diminishes with very great rapidity as the gas cools down after ignition. Thus, Hopkinson found that the products of igniting a mixture of coal-gas and air in a closed cylindrical vessel 1 ft. by 1 ft. lost heat at the rate of 10 gramme-calories per square centimetre per second at the moment of maximum pressure, when the temperature was 1760° C. One-fifth of a second later, when the mean temperature was 1300° C., the rate of heat-loss was reduced to 3½ calories, or only one-third of its value at maximum temperature.† One cause of this is the fact that when the flame first touches the walls the heat is drawn almost wholly from the surface layer of gas in contact with them, and the flow is at first extremely rapid. This surface layer soon parts with its heat; and further supplies have to be drawn from the inner portions of the gas—the cool surface layer now acting as heat insulation. But it is probable that the rapid reduction in radiation as the temperature falls is quite as important a factor in this phenomenon. In the gas-engine it is, of course, accentuated by the reduction of temperature consequent on expansion. The closed-vessel experiments lend confirmation to the view already expressed—that in the gas-engine the rate of heat-flow per unit of area has fallen to a comparatively small value when the piston has moved a short distance out on the expansion stroke.

An important practical consequence of radiation is the greatly increased loss of heat which occurs when the mean pressure in an engine is increased by increasing the strength of the mixture. The jacket loss and the metal temperatures are raised in much greater proportion than the fuel consumption, and the efficiency is diminished. In very large engines this sets a fairly sharp limit to the possible output, which is, as a rule, considerably less than the maximum of which the engine would be capable if it were given all the fuel that it could take. If the load be in excess of this limit, the engine overheats rapidly, in consequence of the greatly increased heat-flow.

3. *The Effect of Cylinder Dimensions on Heat-Flow.*—At first sight it might appear that heat-flow is a surface phenomenon—that is, the number of calories per square centimetre per second passing into the walls of an engine or explosion vessel containing a gas at a given temperature and density should be independent of the volume. This view, which is rather widely held, is, however, certainly erroneous, and probably to a considerable amount. The effect of radiation is necessarily to make the heat-loss per unit area from a large volume greater than that from a small volume, because the walls receive radiation from the inner layers as well as from the portions nearer to them. At some depth, of course, the radiation will cease to be sensible; and when that has been reached, the radiation from the whole mass will not be increased by further increasing its volume. The experiments of David, to which reference has been made, show that the transparency of the products of an explosion while still at a high temperature is very great, and lead to the conclusion that the heat-loss per unit area from a mass of glowing gas would go on increasing with the volume of the mass until that volume is comparable with the largest sizes of gas-engine cylinder now made. David found that the radiation after an explosion in a cylindrical vessel 1 foot by 1 foot was nearly twice as great when the walls of the vessel were highly polished as when they were black. The effect of completely polishing the interior of a vessel is, so far as radiation is concerned, much the same as greatly enlarging the volume of enclosed gas; so that this experiment gives an idea how far the heat-loss from the gas in a cylinder 1 foot in diameter falls short of that in a very large cylinder. It is quite clear that in a 12-inch cylinder the limit of size beyond which heat-loss per square foot does not increase is far from having been reached.

One practical aspect of this question is the relation between size and thermal efficiency. This was fully discussed by Callendar, in a paper read before the Institution of Automobile Engineers in 1907,† who pointed out the probability that some part of the radiation loss was proportional to the volume. If heat-loss were simply a question of the surface exposed, the percentage losses in similar engines should be reduced in proportion to the linear dimensions, and there should be a corresponding increase in efficiency. But in so far as heat-flow increases with the volume, the efficiency of large and small engines will become more nearly the same. Of even greater importance practically is the absolute amount of heat-flow per square foot, since it is this which determines the internal temperatures, and so sets a limit to the output of the engine. The results cited show broadly that this quantity must be considerably greater in an engine of (say) 3-feet bore than in one whose cylinder diameter is only 1 foot, and that the difficulty of designing and working the first is not alone due to the greater thickness of metal, but also to the greater heat-flow.

4. *The Effect of Density.*—The density of the gas in a gas-engine explosion is from four to seven times that of the atmosphere. In the Diesel engine it is, of course, very much greater. The effect of this factor is greatly to increase the heat-flow, as compared with an ordinary closed-vessel explosion, where the density is that of the atmosphere and the vessel similar in size and shape to the combustion chamber. A rough notion of the magnitude of this effect can be obtained by comparisons of the jacket-loss in a gas-engine when the total quantity of combustible mixture is altered by throttling or otherwise; the composition remaining the same. It has been found that the total heat carried away from the jackets increases with the quantity of mixture, but not quite in proportion thereto. A similar result is obtained from closed-vessel explosions. It is found that the pressure after firing a mixture of given composition falls relatively less rapidly when the pressure before explosion is higher, but the absolute amount of heat-loss in a given time is greater.* The quantitative relation between heat-flow and density seems to be complicated and dependent upon the size and shape of the enclosure. In one experiment on a gas-engine of 11½ inches bore, the jacket loss varied as $(\text{density})^{0.9}$ when the density at the moment of the explosion was varied from three times atmospheric to about six times.† After an explosion in a cylindrical vessel 1 ft. by 1 ft., the absolute rate of heat-loss is roughly twice as great when the initial pressure is 1½ atmosphere, as when it is ½ atmosphere, corresponding to the relation‡ $(\text{density})^{0.6}$.

The relation between heat-loss and density in an explosion vessel is dependent upon two factors—viz., radiation and direct surface-loss by convection and conduction. To a first approximation, it may be expected that the heat radiated from a given mass of gas at a given temperature will be independent of the volume which it occupies, because the number of radiating molecules is the same. Thus, to obtain from closed-vessel experiments at atmospheric density an estimate of radiation in a gas-engine in which the ratio of compression is (say) 5, it would be necessary to experiment with a vessel of the same shape as the combustion chamber, but of five times the volume. From the work of David, however, it would appear that the radiation increases slightly with the density, so that the flame in the gas-engine would radiate a little more heat than an equal amount of gas at atmospheric density in the closed vessel.§ The effect of the other element in heat-loss—viz., convection currents—is probably more affected by the density than is radiation, and may perhaps increase in proportion thereto. The heat-carrying power of the gas depends upon its capacity for heat per unit-volume, and this increases in proportion with the density. Thus it may be expected that the amount of heat transferred to the walls from the interior by a given amount of bodily movement of the gas, will increase more or less in proportion to the density. It is, therefore, to be expected that the combined effect of these two factors, radiation and convection, will be to make heat-loss in a vessel of given form increase according to some fractional power of the density.

The most important practical question connected with the relation between density and heat-loss is the effect of degree of compression on the working and efficiency of gas-engines. To put the matter in its simplest form, we may suppose that the engine has a cylindrical combustion space and flat-headed piston, so that the enclosure containing the gas at the moment of firing is a cylinder. The length of this cylinder will in most cases be a fraction of the diameter; the ratio of diameter to length being of the same order as the compression ratio of the engine. The problem, then, is to determine how the amount and distribution of heat-loss to the walls is altered when the compression ratio of the engine is changed (say) by lengthening the connecting-rod. In the ordinary case of a fairly high compression ratio, the effect of this alteration will be to reduce the length of the cylindrical combustion space without changing its diameter, and to keep the mass of gas confined in it substantially constant, so that the density goes up in inverse proportion to the length of the space. At the same time, there will be a small rise in the temperature of the fired mixture, consequent on the higher temperature before firing. This, however, would not be very much—amounting to about 100° C. for an increase in compression ratio from 4 to 6.

The average heat-loss per square foot to the surface will increase, but not in proportion to the density. On the other hand, the area over which the loss is distributed is reduced, but again in a considerably less proportion than the density. For instance, with an engine of equal stroke bore ratio, having a cylindrical combustion chamber, the result of increasing the compression ratio from 4 to 6 will be to reduce the surface of the combustion

* Phil. Trans. Roy. Soc., A., Vol. CCXI., p. 375.
† Proc. Roy. Soc., A., Vol. LXXIX., p. 138.
‡ Proc. Inst. Aut. Eng., April, 1907.

* "The Gas, Oil, and Petrol Engine," by Dugald Clerk (Longmans, 1910), Vol. I., chap. VII.
† Proc. Inst. Civil Eng., Vol. CLXXVI., p. 234.
‡ David, *loc. cit.*
§ David, *loc. cit.*, p. 404.

chamber by nearly 16 per cent. The density is, of course, increased 50 per cent.; and if the heat-loss increases in a greater ratio than the square root of the density (which is almost certainly the case), the effect of this increase of compression would be to increase the total heat-loss, and therefore to diminish the efficiency of the engine relative to the air standard. This in the case supposed would not, of course, lead to any reduction in actual efficiency, because the greater heat-loss would be more than counterbalanced by the increased efficiency due to the increased expansion. But it is clear that if the process were carried sufficiently far, the absolute efficiency might also be reduced. Some approach to this state of things was found by Burstall when the compression exceeded about 7.*

The conclusion gained from practical experience—that there is a point beyond which it will not pay to increase the compression in the gas-engine—is therefore in full accord with the results of laboratory experiments on the relation between density and heat-flow. Not only is there a point beyond which increasing compression is not followed by an increase in efficiency, but before that point is reached the flow of heat per unit area is increased to an amount at which trouble will begin to arise on account of the difficulty of cooling. It is sometimes supposed that the difficulties which arise from pre-ignition when the compression is increased too far are due in some way to the rise of temperature of the gas consequent on the high adiabatic compression. It is very improbable, however, that this has much to do with the matter. The real cause of pre-ignition is the overheating of some part of the interior surface of the metal or of a deposit on it, due to excessive heat-flow following an increased density. If the metal could be kept clean and cool, compression could be carried to very much higher values than are now used in practice without any danger of pre-ignition.

The effect of increasing density on heat-loss is, however, a matter upon which further experimental evidence is needed. A comparison of the rates of loss after explosions in a series of cylinders of the same diameter but of different lengths, the density of the mixture fired being varied in inverse proportion to the length (so as to keep the total quantity constant), would be of great interest. Such a comparison would throw direct light on the heat-flow in an actual gas-engine if among the cylinders tried were some in which the length was a fraction—say, one-sixth to one-third—of the diameter. In many gas-engines the shape of the combustion space is approximately of this character.

5. *Turbulence.*—During the suction stroke of a gas-engine, or during the period of injection in an engine charged from a separate compressor, the mixture of gas and air which is subsequently to be exploded enters the engine through the valves or ports at a high velocity, so that the gas within the cylinder is in a state of eddying or turbulent motion. This motion gradually dies away after the valves are closed, but will persist for some time during the compression stroke, so that at the moment of explosion there may still be a good deal of turbulence. In consequence of this motion of the gas, the convection of heat will go on more rapidly, and what may be called the "effective conductivity" of the gas will be increased.

Perhaps the most obvious direction in which to look for the effects of turbulence in gas-engines is the relation between speed and fuel economy; and this aspect of the matter has been discussed by Callendar, Lanchester, and others. On the one hand, it may be expected that the longer the time taken over the operations of compression and expansion, the more heat (other things being the same) will pass into the walls during that period. As against this must be set the consideration that, with a given valve opening, slow speed means less turbulence—first, because the velocity of entry of the gas is less, and, second, because the time available for the resulting turbulence to die out under the influence of viscosity is longer. Reduction of speed therefore means less effective conductivity; and it is even conceivable that on this account the heat-flow per cycle may be less and the fuel economy greater at the lower speed. The effect of heat-flow upon economy is not very marked; and it is therefore not surprising that no decisive verdict has yet been pronounced on the relation between economy and speed. There is no doubt that, given satisfactory ignition, economy is somewhat improved by increasing the speed; but the relation between these two things has not been so precisely determined as to permit a conclusion to be drawn about the part played by turbulence, nor in view of the complication of the question does it seem likely that much information can be derived from this source. A more promising line of inquiry would be a direct measurement of jacket-losses at different speeds. The Committee are not aware that any very accurate measurements of jacket-loss at different speeds, other conditions being kept rigorously the same, have ever been undertaken. From some rather rough measurements of this character made by various members of the Committee, it appears that the heat-loss per cycle does undoubtedly diminish with increase of speed, but not in proportion thereto.

The complete elucidation of the part played by turbulence in the working of a gas-engine seems, however, to require more direct methods of investigation than the ordinary tests. During the past year, Dugald Clerk has applied his method of indicating the engine with tripped valves, so as to obtain a "zigzag" diagram, to the investigation of this point. During the first expansion line in such a diagram there is present the normal amount of turbulence which obtains in the ordinary working of the engine; during the second and later expansions of the "zigzag," the turbulence has practically died out. We have here obviously a method of considerable delicacy for detecting and measuring the effect of turbulence in causing heat-loss on the expansion line. Clerk has found that in the compression and expansion of air or carbon dioxide without firing, the engine being simply motored round, the rate of heat-loss at a given temperature is greater in the first compression after drawing in the charge than in the subsequent compressions.

For the purpose of studying by this method the effect of turbulence on heat-loss in the ordinary working stroke of a gas-engine, Clerk tried the experiment of drawing in a combustible charge into the engine in the ordinary way, and then tripping the valves and compressing and expanding this charge for one or two revolutions before firing. By this means, the turbulence which, in the ordinary method of working, persists till the moment of firing was given time to die away. It was expected that a comparison of an expansion line obtained in this manner with that following a normal ignition would show the effect of turbulence

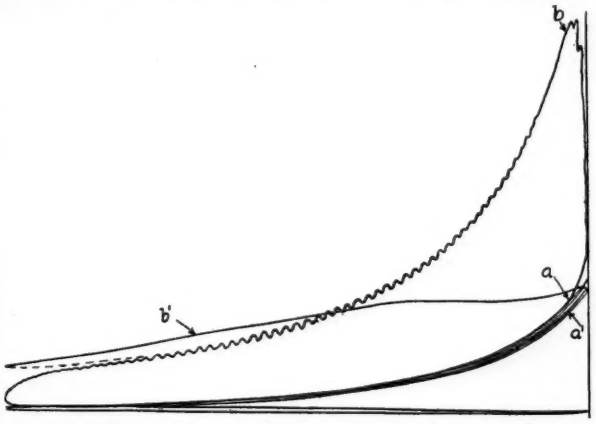


Fig. 1.—Ordinary ignition, *a* to *b*, takes 0·037 second; trapped ignition on third compression; line *a'* to *b'* takes 0·092 second; mixture in both cases, 1 volume gas, 9·3 volumes air and other gases.

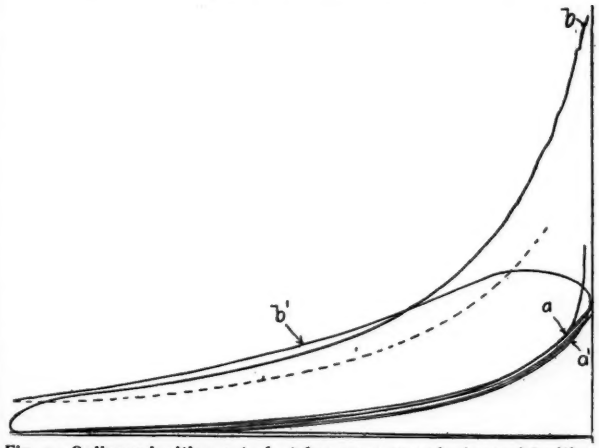


Fig. 2.—Ordinary ignition, *a* to *b*, takes 0·033 second; trapped ignition on third compression; line *a'* to *b'* takes 0·078 second; mixture in both cases, 1 volume gas, 9·3 volumes air and other gases.

on heat-loss. While the experiment did not give any very clear indication on this point, it was the means of bringing to light a matter of perhaps greater importance. Clerk found that the result of damping-down the turbulence was to retard the rate of inflammation of the gas to a very remarkable extent, so that the character of the diagram was completely altered. Two of Clerk's diagrams are reproduced (see figs. 1 and 2), from an inspection of which the importance of this point in the working of gas-engines will be appreciated. If ignition be delayed until the combustible mixture taken into the engine has been compressed and expanded twice and then again compressed, the period of inflammation is about two-and-a-half times that of a normal ignition in which the gases have some turbulent motion. The diagrams shown (figs. 1 and 2) were taken by an optical indicator from an engine of 9 inches diameter cylinder and 17 inches stroke, when running under full load at 180 revolutions per minute. The engine was fitted with two electric igniters; one operating at the charge inlet-valve at the back of the combustion chamber, and the other operating at the side of the cylinder close to the piston. In fig. 1, the back electrical ignition was used; and in fig. 2, the side igniter was in operation. It has been noticed more than once that the period of inflammation in the gas-engine is considerably less than that obtaining in an explosion of a similar mixture in a

* Proc. Inst. Mech. Eng., 1908, p. 5. See also Professor Callendar's remarks in the discussion on a paper by Dr. Watson, Proc. Inst. Aut. Eng., Vol. III., p. 457, where the limit of advantageous compression in the petrol motor is estimated as 4 to 5.

closed vessel of the size of the combustion chamber; and it must have occurred to many that, were it not for this fact, it would hardly be possible to work internal combustion engines at reasonably high speeds, because the ignition would be too slow. It now appears that this is wholly, or almost wholly, due to the fact that the gas in the engine is in turbulent motion.

Simultaneously with the experiments by Dugald Clerk, described in the last paragraph, Professor Hopkinson (with the assistance of his pupils, Messrs. Miley and Peache) carried out some measurements of the effect of turbulence on heat-loss and inflammation phenomena in a closed-vessel explosion. A cylindrical vessel, 1 ft. in diameter by 1 ft. long, was used and was lined with copper strip; the rate of heat-loss being measured by a record of the rise of electrical resistance of this strip. A small fan was mounted in the centre of the vessel and comparisons were made of the result of exploding the same mixture—first with the fan at rest, and second when the fan was driven at a speed of several thousand revolutions per minute. These experiments also showed the great increase in speed of inflammation consequent on the motion of the gas. Taking a mixture of 10 per cent. of coal gas and 90 per cent. of air, the time from ignition to maximum pressure with the gas at rest is about 0·13 second; with the fan running at 2000 revolutions per minute, this time was reduced to 0·03 second, and at a speed of 4500 revolutions per minute to 0·02 second. The effect on heat-flow was also very marked. At maximum pressure, with a 10 per cent. mixture, the rate of flow of heat was approximately doubled when the fan was running at a speed of 4500 revolutions per minute, the mean temperature of the gas in the two cases being the same (about 1600° C.). It is interesting, however, to note that at the higher temperatures reached with a 15 per cent. mixture—say, at 2000° C.—the heat-flow from the gas was not materially altered by the turbulent motion produced by the fan. This is doubtless due to the fact that at such temperatures radiation is an important agent in the transfer of heat; and this would probably be unaffected by the motion of the gas.

For the application of the results obtained with the closed vessel and the fan to the gas-engine, it is necessary to get some measure of the amount of turbulence remaining in the latter at the end of the compression stroke. Mr. H. J. Swain, under the direction of Professor Hopkinson, has made some measurements during the past year bearing upon this point. It is hoped that full details of these experiments, and of those cited above, will be published in the course of the next few months, and the results only need be given here. The method used was to determine the rate of loss of heat from a platinum wire mounted in the combustion chamber of a gas-engine, the wire being heated by an electric current. Within moderate limits of temperature the heat-loss from such a wire is proportional to the temperature difference between it and the surrounding gas. The ratio between heat-loss and temperature difference is a measure of the effective conductivity of the gas, and depends upon its temperature, density, and state of motion. If the first two factors are the same, then the effective conductivity depends only upon the state of motion, and may be taken as a measure of its amount. The wire was mounted in the combustion space of an engine of 7 inches bore and 15 inches stroke, which was motored round so as to compress and expand charges of air, the gas supply being cut off, and comparative measurements of effective conductivity at the top of compression were made first with the engine valves working in the ordinary way, and second with the valves closed, so that the same charge of air was continually compressed and expanded, and there was therefore no turbulence resulting from suction. It was found that at 240 revolutions per minute, the conductivity was more than 60 per cent. greater in the first case than in the second, while at 60 revolutions per minute the difference was only about 20 per cent. In these comparative experiments the temperature and density of the gas were the same, and the difference could only be due to the motion. From measurements of the heat-loss from a similar wire in the closed vessel, Hopkinson infers that the motion of the gas with a fan speed of 2500 revolutions per minute is probably considerably greater than that obtaining in the gas-engine. At this speed, the heat-flow at a temperature of 1600° C. or over is increased by an amount of the order of 25 per cent.; and, while it is certain that turbulence is responsible for some increase of heat-flow in the gas-engine, it is improbable that this is such as materially to affect the thermal efficiency, though it is of importance in the problem of cooling. The great influence of this factor on this manner of inflammation which has been disclosed by these experiments of Clerk, and of Hopkinson also, makes the subject worthy of more detailed investigation.

[The Committee consider that their work can be continued with advantage; and they therefore recommend that they be reappointed. Out of the grant of £60 allotted to the Committee at the Portsmouth meeting, £45 has been expended in assisting individual members with experimental work. The Committee are of opinion that the Association grant would be better applied if the whole of the money could be assigned to one laboratory, where experiments having a direct bearing on the work of the Committee could be carried out. Arrangements with this object are under consideration and will, it is expected, be concluded before the meeting of the Association. In these circumstances, the Committee feel justified in asking for a grant of £100.]

Discussion.

Mr. C. E. Larard asked if the Committee proposed to make any investigations as to the effect on combustion by adding small quantities of moisture to the charge. It was well known that certain makers of internal combustion engines were introducing a water-spray in connection with their engines, so that a small charge of water could be taken into the cylinder; the idea being that this gave a smaller clearance space and a high compression pressure, with a greater maximum stroke pressure. It was obviously of importance that the hygrometric and the atmospheric conditions should be taken into account with internal combustion engines. For instance, he had found that a four-cylinder motor-car engine ran better on wet days than on fine days.

Dr. Dugald Clerk said that several experiments had been made by the Committee with the use of water. It had been found that this increased the ease of running, and allowed higher compressions to be used, because the temperature of compression was greatly reduced. By the use of water, it was possible to use compressions which would cause pre-ignition without the water; but there were many other ways of bringing about the same result. In many of the National Gas-Engine Company's engines they took some of the exhaust gas, cooled it, and mixed it with the engine charge. When using coke-oven gas, carbonic acid from the exhaust was often introduced into the charge; and in this way it was possible to use compressions which they would not be able to do otherwise. The general effect of adding water to the charge was to reduce economy, but it increased the mean pressure. The question was receiving the most careful attention on the part of the Committee. A good deal of investigation was, however, necessary yet, as only a moderate quantity of water would result in the loss of economy altogether.

Professor W. E. Dalby pointed out that the discovery of the phenomenon of turbulence was due entirely to Dr. Clerk; it having been discovered and worked out in his own laboratory, and the results passed on to the Committee.

High-Pressure Gas for Leeds Markets.

Following up this matter (referred to in our columns last week), we learn that the Leeds City Council, at their meeting on Wednesday, confirmed *nem. con.* the action of the Markets Committee in adopting high-pressure gas for the markets area. The electricians had, it seems, so weak a case that they offered neither criticism nor comment—much to the disappointment of several members of the Council, who would have been glad to have stated publicly the reasons which led to the Markets Committee's decision. It was probably rather a disappointment to Mr. Walter Hole also, as a Council debate would assuredly have been a capital advertisement for his department.

Swiss Association of Gas and Water Engineers.

The thirty-ninth annual general meeting of this Association will be held from the 21st to the 23rd inst. at Coire (Chur). The proceedings will open with an assembly on the evening of the 21st; and technical papers will be read and discussed the following morning. The papers to be presented include: "How Many Gas-Works could Realize a Higher Profit," by Dr. Knublauch, of Ehrenfeld, Cologne; "Novelties in Heating by Gas," by Herr Fischer, of Stuttgart; "Two New Charging and Discharging Machines," by Herr A. Eitle, of Stuttgart; the report of the Photometric and Heating Committee of the Association, by the Secretary, Dr. Ott, of Zürich; and a paper on the Zürich Electricity Works at the Albula, by Herren Peter and Wagner, of Zürich. Other technical questions will also be discussed, with a paper of local interest. In the afternoon of the 22nd, the Coire Gas-Works will be visited; and in the evening the official banquet will be held. Monday, the 23rd, is to be devoted to an excursion, in the course of which the Albula Electricity Works of Zürich will be visited. The members of the Austrian Association of Gas and Water Engineers have been invited to participate in this meeting.

Standard Specification for Structural Steel.

We have received from the Secretary of the Engineering Standards Committee (Mr. Leslie S. Robertson, M.Inst.C.E.) a new edition, which has recently been published, of the British standard specification for structural steel. The new issue is of importance in view of the fact that the London County Council (General Powers) Act, 1909, requires that all rolled steel used in the construction of skeleton framework for building shall comply with the requirements of this specification. Since its first issue in June, 1906, the Committee had brought before them from time to time points which had arisen in connection with its use; and the present edition embodies the necessary amendments in regard thereto. Some of the more important modifications to the specification are as follows: (1) The classification of the material dealt with into two categories—A steel and B steel. (2) The increase of the allowable phosphorus content in the latter steel from 0·07 to 0·08 per cent. (3) The increase of the upper limit of tensile strength for plates, sections, and bars (other than rivet bars) from 32 to 33 tons per square inch. (4) The reduction of the lower limit of tensile strength for rivet bars from 26 to 25 tons per square inch. (5) The insertion of clauses dealing with (*a*) tests by an independent expert, (*b*) rejection after delivery, and (*c*) arbitration in cases where this is not otherwise provided for. The price of the specification is 5s. 2d. post free; and it may be obtained from any bookseller or direct from the offices of the Committee, No. 28, Victoria Street, Westminster, S.W.

THE PAPERS AT THE NORTH BRITISH ASSOCIATION MEETING.

AUTOMATIC GAS LIGHTING AND EXTINGUISHING.
By Mr. George Keillor, of Broughty Ferry.

GOVERNORS: THEIR ACTION AND APPLICATION.
By Mr. W. Carmichael Peebles, of Edinburgh.

SOME NOTES ON LIGHTING APPLIANCES.
By Mr. S. B. Langlands, of Glasgow.

} READ AND DISCUSSED.

A YEAR'S WORK WITH VERTICAL RETORTS.
By Mr. William Blair, of Helensburgh.

} PRESENTED.

(I.)

AUTOMATIC STREET LIGHTING AND EXTINGUISHING.

By George Keillor, of Broughty Ferry.

To light and extinguish gas street-lamps from a central station, or by any other automatic means, has been the aim and object of several ingenious arrangements for many years past. In 1873—and this is not by any means the first recorded attempt at automatic lighting and extinguishing—Mr. Abraham Malam exhibited a patent electric lamp lighter at a meeting of the West of Scotland Association of Gas Managers held at Dumfries. Then, among others, the late Mr. Foulis, of Glasgow, and Mr. Smith, of Ayr, were early to the front with devices for the automatic lighting and extinguishing of street-lamps; and in 1888, Mr. Keillor, while at Nairn, devised an ingenious combined pressure wave and electric lighter, which is fully decribed in the "Transactions" of this Association.

In 1877, the "Journal of Gas Lighting," when commenting upon a paper submitted by Mr. A. F. Wilson to the British Association of Gas Managers, entitled "Automatic Street Lighting and Extinguishing," wrote as follows:—

> The lamplighter of our juvenile days, with his light ladder and flaming torch, with whom we have run many a race, is hopelessly extinct. For the moment he is replaced by a well-dressed man, who perambulates the streets with an important-looking wand, and who only wants a gold-laced hat and a cloak and collar to match to cause him to be taken for a city ward beadle. He, too, according to Mr. Wilson, is destined for extinction. In the future, gas will be lighted and extinguished automatically—one hand on a valve at the gas-works having entire control over the matter. It must be admitted at the present moment complete success in this direction has not been achieved; but, as our apparatus of distribution is perfected, automatic lighting will become more and more possible. To day it is little more than a dream.

When those words were penned, they reflected the advanced opinion of the time, and foretold the coming of the automatic gas lighting and extinguishing period. Now that the day of practical automatic lighting has dawned, our excellent friends the "Journal of Gas Lighting," must feel justly proud of their thirty-five-years-old prediction.

Automatic lighters may be operated by electricity, by clockwork, and by gas pressure. But distance-lighters for street-lamps actuated by electricity have not met with any success, as the expense connected with them is too high. On the other hand, clockwork and gas-pressure distance-lighters have become a favourite medium, as they appear to have proved themselves, wherever they have been adopted, a very lucrative investment. Unfortunately, I am not at present in a position to drive this point home, having only had a few weeks' experience upon a working scale; but, as the result of a carefully conducted inquiry extending over eighteen months, I am confident the adoption of the "A & M" pressure-wave system of lamp lighting and extinguishing will be a profitable and most efficient system for the burgh I have the honour to serve.

When first I promised our esteemed President a paper upon this subject, I had in view the early erection and completion of an installation of pressure-raising plant at Broughty Ferry; and I had hoped to gain experience with the new lamp-lighting appliances, which might have been of practical value to members of this Association. But, owing to the coal strike and other labour upheavals, over which we had no control, the delivery and erection of the plant were many weeks behind. Consequently, the practical results I at one time hoped to put on record are not available. Under the circumstances, therefore, I hope the remainder of my communication may prove of some interest.

It is well known that street-lamps are a source of considerable loss to gas undertakings, and also to lighting authorities, through lamplighters failing to keep the exact times laid down for the lighting and extinguishing of the public lamps. The desire to eliminate this variable factor, and also to save the expense of, and actual manual labour involved in, a personal visitation of every lamp twice or thrice daily, has led to many lighting devices being placed upon the market. It is obvious, too, that under the manual system great waste of gas must take place owing to many of the lamps being lighted long before they need be if all the lamps are to be alight by the time they are required—and it is the custom to so arrange the lighting schedule that the last lamp on each lighter's section is lighted just before it is dark. To these original considerations has now been added the imperative necessity of protecting the fragile mantle from the shocks and vibration incidental to the most careful manipulation of a lamplighter's torch.

The lines upon which any automatic apparatus for lighting and extinguishing public lamps may proceed are twofold—namely, those designed to affect simultaneously any number of lamps from one common centre, and those dealing with each lamp separately. I do not think it is necessary to enter into the technicalities of the various automatic systems of gas lamplighting, because every member of the Association is as fully versed in the subject as is the writer himself. I shall therefore confine myself to a simple review of the advantages of the unit and the collective systems of automatic control, and at the same time describe shortly the system introduced into Broughty Ferry after close consideration of both systems.

Unit System.

In the unit system, we have apparatus with clockwork which operates the opening and closing of the lamp-cocks. Each lamp possesses one apparatus independent of all the other lamps, and each lamp is lighted and extinguished according to schedule time only. In the unit system, the clockwork is generally set to operate at certain times, night and morning, in conformity to a lighting time-table or schedule. This is termed the unit or individual system, because each clock is set to light up or extinguish a particular lamp independently of the others. Each lamp is dealt with separately, and there is no interference with the ordinary pressure. The clockwork requires winding and setting weekly, according to the schedule time for lighting and extinguishing the lamps. This system is applicable to all-night or morning lamps, as well as to the ordinary evening lamps. The principal clockwork controllers are the "Gunfire," the "Horstmann," the "Simplex," and the "Automaton." The "Automaton" controller is a clever combination of the clockwork and pressure-wave systems, and, strictly speaking, it belongs to the collective class of controllers.

The clockwork or unit controller is largely used in towns where, it is said, owing to the hilly nature of the district supplied, to the sudden and varying demands for gas, and to the indifferent state of the mains, &c., it has been found inexpedient to introduce the collective or pressure-wave system centrally controlled. But now, after the experience of a hilly and busy manufacturing city such as Newcastle—and I must here compliment the Newcastle authorities and their officials upon their splendid installation of automatic street lighting—and other towns, including our own, I am fully of opinion that the collective or the pressure-wave system is universally applicable.

Collective System.

In the collective system, the apparatus actuates the lamp-cocks at the time of lighting and extinguishing, by means of different gas pressures in the mains; the gas pressure being controlled at the gas-works governor. This apparatus operates simultaneously through the whole lighting area; and it is possible to actuate the lamps just at the beginning of dusk and of dawn, or at any other time, according to a fixed schedule or otherwise. The principal pressure-wave controllers are the "A. & M.," the "Automaton," the "Bamag," and the "Rostin."

The collective or pressure-wave system offers the advantage that lights can be turned on or off in the street-lamps without any special attendance (such as the winding and setting of clocks, in order that the apparatus may operate as near schedule time as possible). The collective system is at the same time independent of any existing lighting time-table, because the time of lighting up and extinguishing may, without any preparation whatever, be altered to suit the daily variation in the weather requirements, with corresponding economies in the gas bill.

The technical and economical advantages of the collective systems of automatically controlling the public lighting of any area, as against the ordinary method by manual labour, are as follows:

1.—The possibility of lighting or extinguishing the whole of the lamps in the space of a minute, and the facility with which the lamps may be lighted at other than the usual hours in case of sudden fog or gloom.

2.—That an absolutely reliable attendance to public lighting is no longer dependent on the certainty or uncertainty of the lamplighters.

3.—The lighting and the extinguishing of the lamps being so quiet and easy, pushing, pulling, or knocking with the torch on the lamp-cocks is entirely avoided; and, consequently, the vibration of the whole lamp does not exist, and the ignition of the gas takes place without any explosion.

4.—The saving in mantles and chimneys (where glasses are used) due to the elimination of the shock involved in the opening of the lanterns for cleaning, &c., the turning of the stopcocks, and the use of the torch. Maintenance of the lighting system is thereby greatly reduced.

5.—The saving in wages due to the personal attention to each lamp twice or thrice daily by the lamplighter in the usual way being dispensed with.

6.—The saving of gas due to the lamps all being lighted up simultaneously and extinguished simultaneously at the exact time they are required. But against this must be put the cost of the gas required to maintain the bye-pass jets.

The unit system has nearly all the advantages enumerated above, though not quite to the same extent as the collective system. A disadvantage of the unit system is that the apparatus needs periodical attention—say, weekly—for the purpose of winding up the clockwork and adjusting the times for the mechanism to come into operation. But as a personal visitation for the purpose of cleaning the lamps would be necessary under any system, this resolves itself into a question of the additional time required for adjustment when the lamp is being cleaned. There are certain other disadvantages incidental to the use of clockwork in exposed positions—such as condensation of moisture, dust, repair of clocks, synchronization, and, of course, irregularity in lighting and extinguishing.

Automatic lighting is perfect only when it is under central control. The collective or pressure-wave system being under central control, it becomes the ideal system, because it allows the whole of the lamps of any undertaking to be simultaneously lighted and extinguished at will.

The first experiments to utilize gas pressure for operating distance-lighters by a pressure wave (a temporary increase of pressure above the normal), have shown that such a pressure wave can be transferred through the whole of the system of mains with astonishing velocity, even to the remotest outskirts, and to any distance. Therefore a wave of a certain height is sufficient to operate at any time all the gas street-lamps of a town simultaneously. The success of this system, however, depends upon whether or not there is always an excess of pressure available above the ordinary maximum pressure applied to the town. For successful working, there must always be an excess of pressure available for operating the controllers, and the method of applying the excess pressure must be reliable and safe.

Now, apart from the type of controller, &c., employed by us (see Appendix), perhaps the method we have adopted of applying the pressure wave is the only other interesting feature of this paper. The largest holder at our works throws a pressure of 47-10ths when fully inflated, but only 30-10ths (our present maximum night pressure) when uncupped. Owing to this drop in holder pressure, and the determination of my Council to adopt the pressure-wave system, I had to obtain other reliable means of temporarily increasing the pressure for lighting and extinguishing the lamps. It was first suggested to my mind that the holder might be weighted to give the necessary increase in pressure; but I soon discovered that such a method was impracticable. In my opinion, there is no better or safer way of applying the pressure wave than by means of the gasholder and a good water-loading governor; but it is only courting disaster to proceed with an insufficient margin in gasholder pressure and inefficient governing appliances.

I would here emphasize the necessity for exercising care in the manipulation of the governor. To save time, neither a water-loading nor a counterbalanced governor should be pressed down by hand till the pressure on the outlet has been increased to the required degree. Neither do I approve of the temporary opening and closing of the governor bye-pass valve for the purpose of increasing the pressure, unless a safety governor is fixed on the town's main, and adjusted so that only the increased pressure desired passes to the town. Failing such an arrangement, the pressure must be applied, or built-up slowly, by legitimate means, and according to the established practice; otherwise consumers' troubles will appear. Where wet meters are in use, they must be efficiently watered four times a year, and consumers' gaseliers should be inspected, watered, and then some oil added to prevent evaporation. The forty to fifty year old wet meters should be removed for good; and, if numerous wet meters are in use, the spindle tubes should all be fitted with stuffing-boxes to prevent water and gas escaping accidentally. This latter precaution, of course, is only absolutely necessary where the pressure applied is from 4½ inches upwards.

We have now been experimenting with a 4½-inch pressure wave for eighteen months; and so far not one complaint has reached the gas office regarding the temporary 1½ inches increase in pressure. Indeed, there have been, strange to say, several applications for a higher maximum night pressure than 30-10ths, because of the better light obtained during the short time the increased pressure is on the district for lamplighting purposes.

But this is a digression. After a series of experiments extending through the summer and autumn of 1911, the available holder pressure was proved to be insufficient for operating the lamp-controllers at extinguishing time. It was then decided to introduce an electrically-driven fan, suitably governed, and coupled-up between the inlet and outlet of the station-governor, for pressure-raising purposes. The capacity of the fan having been fixed, and special surveys made to find out the district pressures at numerous points, several manufacturers of high-pressure plant were invited to tender for our requirements; it being a condition that when the fan was running there would be no oscillation of the lights throughout the town, and that at no time would it be possible to exceed the predetermined pressure on the district. The Bryan Donkin Company were entrusted with the contract, and a short description of the plant and electrical equipment is given in the Appendix.

The motor fan and switch panel are accommodated in the governor-room at the gas-works, and details are so arranged that either a member of the gas-works staff or the chief attendant from the inspector of lighting's department may apply the pressure wave. Meantime, the gas-works staff perform this responsible duty; but we may ultimately decide to invite the inspector of lighting to be wholly responsible for the duties of his paid office. In that event, the attendant would only have access to the switch-panel.

Our method of applying the pressure wave is as follows: On entering the governor-room, the attendant simply presses the handle of an automatic electric starter, and the motor-fan and pressure recorder does the rest. The fan is run for two minutes, and then the attendant stops the motor by cutting off the current. There are no valves to be opened and closed either before or after the motor-fan is started and stopped, because the 8-inch special pressure-regulator on the outlet of the fan is arranged to lift to open and to fall to shut. The arrangement is thus quite automatic in its action—one hand on a lever at the gas-works having entire control over the matter. To-day automatic lighting and extinguishing is a reality. It is no longer a dream.

There are 650 lamps in Broughty Ferry; and, as the lanterns were old and in bad condition, it was decided to provide new lanterns, frogs, and full-way stopcocks, while the "A. & M." pressure-wave apparatus was being installed. The estimated cost of the whole installation, comprising the lanterns, frogs, and stop-cocks, controllers, and angle inverted burners (consumption 2½ and 4 cubic feet per hour), the repair and renewal of service-pipes, and the pressure-raising plant at the gas-works, was £1775. The estimated saving to be made per annum was figured at £110, notwithstanding the fact that the lighting department was under-staffed when the estimate was prepared. If the department had been properly staffed, the saving would have been estimated at £175. In addition to the money saving, there is the satisfaction of having a much better lighted town, and the introduction of the system means progress, comfort, and independence of labour troubles. A saving of £110 is equal to a return of 14⅝ per cent. on the cost of the installation, *minus* the cost of new lanterns, frogs, and the pressure-raising plant. The cost of the pressure plant, I may add, is being defrayed by the Gas Department.

It has been found by experience that a man or young lad, provided with a bicycle and light folding ladder, can quite comfortably overtake the inspection of 250 lamps nightly, and also clean the lamps on his section of the system once a fortnight. The area of Broughty Ferry, exclusive of the foreshore, is 1138 acres, and the length of the burgh between the east and west boundaries 2·78 miles. The greatest width is 1·27 miles, and there are 29 miles of roads and streets. The length from the gas-works to the eastern boundary is 1·21 miles, and to the western boundary 1·62 miles. The length from the gas-works (15·4 feet above O.D.) to the greatest altitude (137·7 feet above O.D.) is 1·63 miles. One-half of the burgh may be said to be flat and the other half hilly. At the hour of greatest consumption, the pressure at the eastern boundary is 28½-10ths, and at the western boundary 29½-10ths. At the greatest altitude the pressure is 40-10ths. Since the automatic lamp-lighting scheme was inaugurated in July, it has been an unqualified success; and with experience, the failures incidental to the starting of the new system have been entirely eliminated. At the present time there are 1890 actuations made nightly; and, upon an average, there are seven failures per night. The rate per cent. of failures from all causes on actuations is thus only 0·370; and the rate per cent. of failures, calculated upon the number of lamps in use, 1·129. Investigation has proved these failures to be attributable to a fault in the supply pipe; and as the same lamps are always affected, it may with truth be said that the system is faultless. Needless to say, these services will receive our attention when time permits.

With a view to keeping an accurate record of the working of the installation, suitable books and forms have been devised, specimens of which are included in the Appendix. Form C is in duplicate, and is filled up by the pressure-wave attendant. A book of forms lies in the governor-room at the gas-works, and each day a copy form is sent to the inspector of lighting on completion. Form D is filled up by each of the lamp attendants, and copies sent to the Gas Engineer daily. These forms are filed on the loose-leaf principle; and at the present time the inspector of lighting is considering the advisability of having an index card for every lamp, so that a complete record of the working, &c., of each individual lamp may be seen at a glance.

By the introduction of distance lighting and the use of inverted incandescent burners, an elasticity and an efficiency of service are obtained, in addition to other advantages, which cannot be

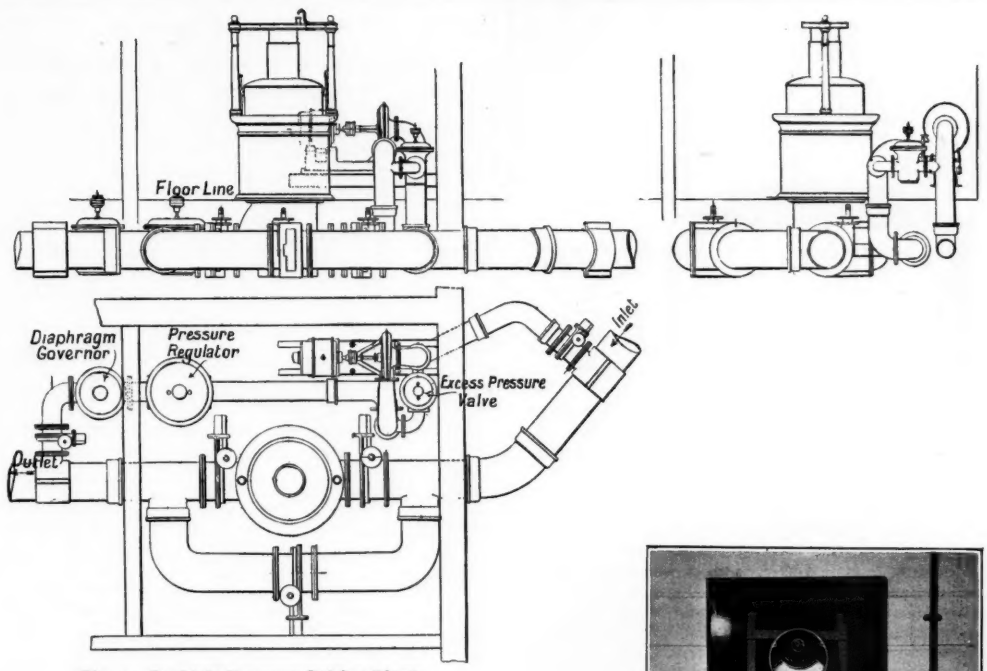


Fig. 1.—Donkin's Pressure-Raising Plant.

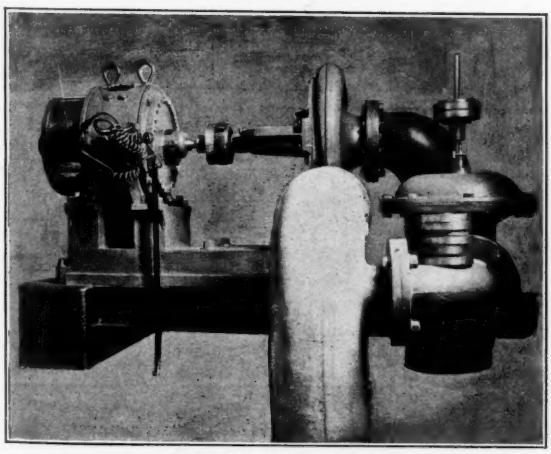
expressed by a money factor. By it not only a saving in cost of street lighting is achieved, but an installation of public lighting is obtained which is second to none.

APPENDIX A.

Pressure-Raising Plant.

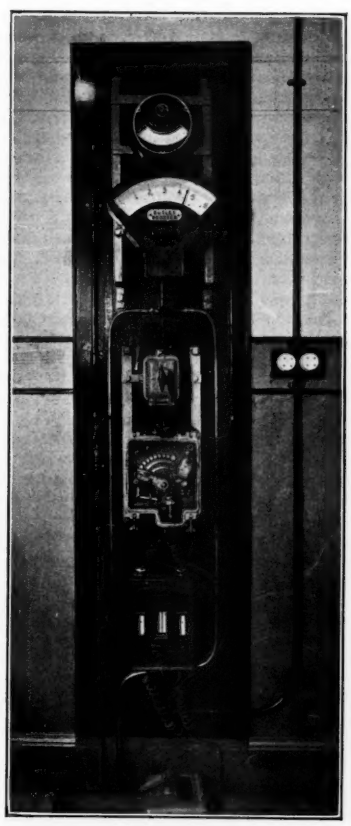
The plant illustrated consists of a fan capable of dealing with 30,000 to 40,000 cubic feet of gas per hour, and raising the pressure 15-10ths above the ordinary working pressure, so as to operate the automatic lamplighters. The fan is driven by an electric motor through flexible coupling, and the fan and motor are mounted upon a suitable cast-iron bedplate. The motor is for direct current, is shunt-wound, and totally enclosed with interpoles, of 1½ B.H.P., and capable of 2100 R.P.M. The switch panel consists of an iron frame carrying a double pole switch, fuses, and an "Autograd" automatic starter with no-volt release, all iron clad. An ammeter and a Simmance-Abady dead-beat gas-pressure indicator go to complete the arrangement.

A special feature of this plant is that it is capable of being started or stopped from a distance, and without having to operate rack-valves. This has been accomplished by means of the pressure-regulator and governor shown. When the plant is started-up by means of a switch, gas is taken in by the fan and passed along the outlet-pipe to the 8-inch pressure-regulator. This regulator is so weighted that it does not open until the pressure between the fan and regulator rises above the maximum pressure of the holder or other desired pressure. When this takes place, the fan passes the gas direct into the district, and so creates the increase of pressure desired to operate the automatic lighters.



View of the Motor and Fan.

When the pressure on the district rises to the desired pressure for working the lighters, the diaphragm governor rises, and so prevents the predetermined pressure being exceeded. When the fan outlet is closed, the excess-pressure valve comes into action, and helps to bye-pass some of the gas back to the inlet, and so the plant can be left running without doing any harm. When the plant is stopped, the 8-inch pressure-regulator falls and closes,



View of the Switch Panel.

and the 8-inch diaphragm governor falls wide open, owing to the pressure on the district having fallen. The 8-inch pressure-regulator, being closed, prevents gas bye-passing the town governor. From this, it will be seen that, once the plant is set for a given pressure, it will automatically come into action when started or stopped.

APPENDIX B.

The "A. & M." Patent Street-Lamp Lighting and Extinguishing Apparatus.

The controller (fig. 2) consists of a steel bell working into a cast-iron tank, which has a lute containing 6 ounces of mercury as a seal. The valves and guides are wholly contained inside the bell. The bell is weighted to overcome the maximum working pressure on the district, and it is only when the excess pressure is applied that the bell rises and brings about the lighting and extinguishing of the lamps. [During the time the controllers were being adjusted, we maintained a pressure on the town about 2-10ths in excess of the maximum working pressure, and merely weighted the bells to overcome this.] When the bell is raised by the predetermined pressure increase, a pendulum link attached to the crown of the bell engages in the teeth of the plate of a disc valve, and causes it to rotate. This movement is employed to open or close the gas-way to the burner. On the inner cast-iron wall of the lute there is a cone of steel, upon which the dome rests when the actuating pressure is not being exerted. This cone prevents mercury from entering the inside of the chamber, if it happens to

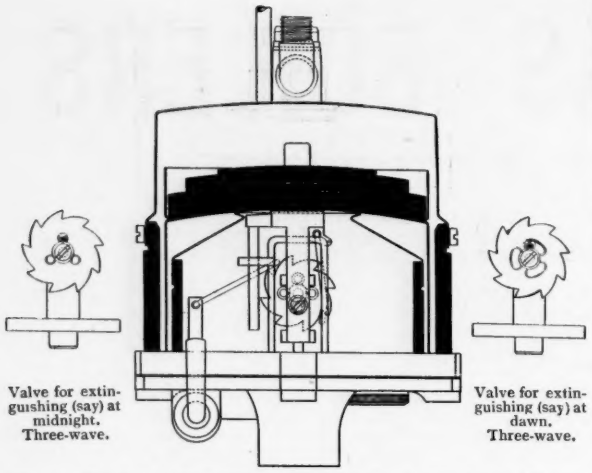


Fig. 2.—The "A. & M." Patent Automatic Gas Apparatus for Street Lighting.

be splashed up by violent means, and returns it to the lute again. On the top of the bell is a tray in which the weights counterbalancing the pressure are placed; and the whole is encased by a cover fitted down tightly upon a turned rim. This cover serves two purposes. In the first place, it prevents the admission of dust and insects, and in the second it forms an air-cushion and steadies the action of the bell. The vent-hole in the cover is made small in comparison with the area enclosed, and the cushion thus interposed effectually prevents the apparatus being operated by the oscillatory action caused in the mains by wind pressure on gas-holders supplying comparatively small areas. Below the floor of the controller there is a crank-handle by which the disc-valve may be at any time actuated by hand. The purpose of this crank-handle is to make it easy for anyone who is fitting on a mantle or adjusting the burner to turn on the light and extinguish again without removing the cover. Or if by any means a lamp got out of cycle with the remainder of the installation, it could at once be restored by operating the crank-handle.

The apparatus installed is on the three-wave system. The first wave lights all the lamps simultaneously, the second wave extinguishes the evening lamps, and the third wave extinguishes the morning lamps at dawn. The slots in the disc-valve of the controllers fixed in double-burner lanterns are so arranged that one burner only is extinguished at midnight, the other remaining alight till dawn. The apparatus may be adopted to varying lighting conditions. Lamps in unimportant streets may be extinguished while those in busy and important thoroughfares remain alight, or the lamps may be extinguished in groups as required.

A detailed description of the working parts of the "A. & M." controller is given in Hole's excellent book on the "Distribution of Gas."

Lantern, Frog, Burner, &c.

The "Edinburgh" hurricane-proof lantern by Messrs. Alder and Mackay, of Edinburgh, is made of the best cold-rolled copper, putty-glazed, with enamelled crown plate, and hinged top. The

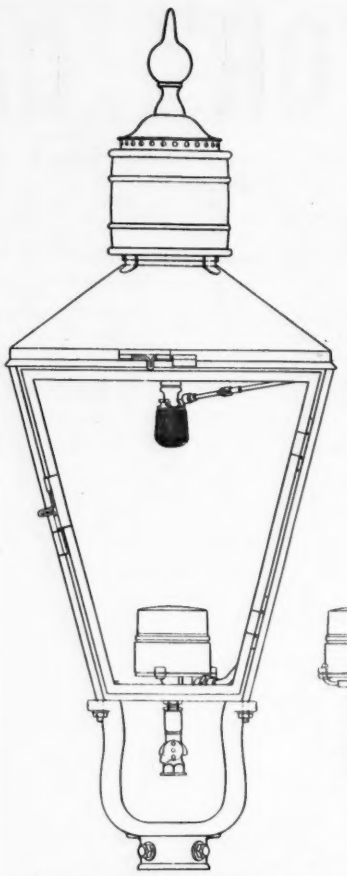


Fig. 3.—Hurricane-Proof Street-Lantern. The "Edinburgh" Pattern.

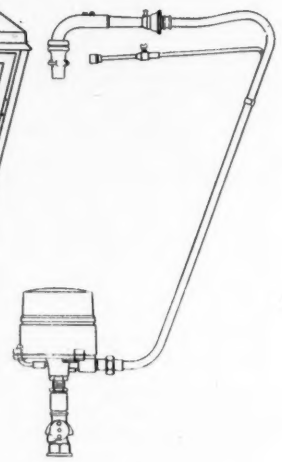


Fig. 4.—Lighting Apparatus with Angle-Fitting Passing over Reflector, for Inverted Burner.

lantern has two doors, admitting of the cleaning being done always on the lee side. The lantern is guaranteed rainproof, and the fresh-air inlet and waste-gas outlet are properly proportioned. The incoming fresh air is heated by contact with the waste-gas outlet before reaching the burner, thus ensuring a high candle-power efficiency per foot of gas consumed. Each lantern is provided with a suitable number stencil in zinc.

The cast-iron frog has been made specially strong, in order to give rigidity to the lantern and to check vibration. This is of importance in preserving the life of the mantle and maintaining a steady light. The stopcock has been specially designed to suit our requirements. It is "fullbore" and leverless; and it cannot readily be closed by unauthorized persons. The burner employed is Bray's horizontal inverted incandescent burner with magnesia nozzle, and all burners are carefully nippled to consume $2\frac{1}{2}$ and 4 cubic feet per hour, as the case may be.

APPENDIX C.

PRESSURE-WAVE OPERATOR'S REPORT (Street Lighting Department).

DAILY TIME SCHEDULE, &c.

Operator's Name _____ *Date* _____ 19

	Schedule Time.		Actual Time.		Hours in Use per Burner.		No. of Burners in Use.				GAS USED.		
	H.	M.	H.	M.	H.	M.	At $2\frac{1}{2}$ C.F.	At 4 C.F.	C.F.	Total.	Lamps. C.F.	Bye-Pass Gas. C.F.	Total. C.F.
LIGHTING. All lamps													
EXTINGUISHING. Evening lamps . . .													
Morning ,, . . .													
					Totals for day								
					Totals brought forward								
					Totals to date								

	Evening.	Morning.	Total.
Number of single-burner lamps			
Number of double-burner lamps			
Total			

Remarks :—

APPENDIX D.

PRESSURE-WAVE ATTENDANT'S REPORTS

(STREET LIGHTING DEPARTMENT).

Date, _____ 19

CAUSES OF FAILURE.

A.—Bye-pass out. D.—Service choked. G.—Irregular operation.
B.—Shortage of Pressure. E.—Apparatus out of order. H.—Cock turned off.
C.—Vent-hole choked. F.—Burner lit-back. J.—Other causes.

LAMP.		FAILURES.			THINGS REQUIRING ATTENTION.
		Lighting.	Extinguishing.		
STREET.	Registered No.	All Lamps.	Evening Lamps.	Morning Lamps.	
Example—					
Constitution . .	430	A.	..		
King	370	B.	..		
Lawrence . .	600	..	G.		
Brook . . .	210	..	..		Pane glass broken
Castle . . .	515	J.	..		Mantle renewed

_____ *Attendant.*

Note.—The above "faults" are registered daily.

(II.)

GAS-GOVERNORS: THEIR ACTION AND APPLICATION.

By W. CARMICHAEL PEEBLES, of Edinburgh.

When your esteemed President first asked me to give to the Association a paper on gas-governors, I had some hesitation in agreeing, as I was then under promise to deliver to the Scottish Juniors' Western District, a paper on the same subject, which was read on the 7th of October last.* In it I touched on practically all types of governors presently in use; and I therefore feel that, to a certain extent, I must now traverse some of the same ground, although treating the subject in a slightly different manner. I hope, then, you will bear with me if the matter is not so fresh or novel to you all as it might be, for the subject is nearly as old as the gas industry itself, and has been dealt with at different times by numerous writers in papers and text-books.

When the governor was first invented by Clegg in 1815, the object in view was to prevent gas consumers using too much gas, as in those days there were no meters. Gas was charged at so much per burner for a certain number of lighting hours; and naturally an increase of pressure increased the amount used without a corresponding increase in the price paid for it.

There was only one governor then, and consequently it was called the governor, now named the station governor, to distinguish it from the many other types at present in use. Accum published his "Practical Treatise on Gas Light" in 1819; and in it is shown a drawing of a station governor having a bell and float, and the cone-valve giving a gradual opening or closing for a large movement of the bell. It is remarkable that we find the governor at the present day so little different from the earliest type; the chief change being in the valve arrangement to deal with the higher and more varying inlet pressures now in use, due to larger and heavier gasholders with single and multiple lifts. The equilibrium governor is now universally used. It has double valves of equal area, or the single valve with a bell of equal area, upon which the varying inlet pressure, by acting in opposite directions, is so neutralized that it has no effect on the moving parts. [Two or three well-known examples of these governors were here shown on the screen.]

The retort-house governor for controlling the conditions of exhaust in the hydraulic main was invented by Newton in 1852. The design shows an inverted bell, sealed in water, hanging from one arm of a counterbalance beam, to the other end of which a rod is attached, and descends to actuate a throttle-valve in the foul main. Standing upwards from the centre of the beam is another arm, which (through bell-crank levers and connecting rods) adjusts the throttle admitting steam to the exhauster. We have thus two governors in one; and, although the arrangement is very simple, its benefits do not appear to have been recognized until recently, when the retort-house governor as we now know it came into prominence.

In this governor the weight of the bell and valve may either be carried by a float attached to the side of the bell or by a counterbalance. The gas from the retorts being admitted to the under side of the bell raises or lowers it and the valve according to the "make," and thus allows the exhauster pull to have more or less effect in drawing off the gas. Should the exhauster pull vary, the effect is also carried to the bell, and combines to adjust the position of the valve. The weights on the bell or counterbalance give a means of adjustment to meet varying conditions.

With an efficient exhauster governor regulated from the hydraulic main, a satisfactory gauge at the retorts can, no doubt, be maintained; but even in such a case the retort governor proves an additional safeguard towards the maintenance of that condition. Without a governor, one would hardly feel safe in reducing the seal to one-tenth to two-tenths. With a deeper seal, the pressure holds the gas in the hot retort, where it is churned about, which alters both its character and its quality. Another advantage gained by using these governors is the greater absence of carbon deposit in the retorts.

* See "JOURNAL," Vol. CXVI., p. 114.

DISTRICT PRESSURE GOVERNORS.

The distribution of gas is claiming more and more attention from gas engineers as time goes on; so that our district pressures are becoming less variable. Owing to the special demands for gas in certain districts of our distributory system, or owing to overworked mains or hilly districts, the station governor cannot, although acting with perfect precision, control the pressures at all points. Consequently, special district governors are used, either of the station governor type, giving a constant outlet pressure, or else of the differential type, reducing the pressure by some predetermined amount.

The natural lightness of gas compared with the weight of the atmosphere causes it to exert an upward pressure on the surface of a vessel containing it, such as is observed in its power to lift a gasholder or a balloon. So we find in practice that there is an accession of pressure of about one-tenth water-gauge for every 10 or 12 feet of elevation; and if the ascent is steep and the mains are of considerable length, the increase becomes troublesome. Here the differential district governor comes to our assistance, as by its use we can reduce the pressure where we wish by any predetermined amount; and at times when the station governor pressure must be increased, the differential governor gives automatically a similar increase to its district.

The alteration of the inlet pressure, due either to the changing of the pressure at the station governor or to the varying consumption between the two governors, alters to the same extent the outlet pressure on the differential governor; but, on the other hand, the outlet pressure from the latter remains constant for a varying consumption so long as the inlet pressure remains constant. [Some designs of these governors were here shown upon the screen.]

With the pressure-wave system for automatic lighting, it is necessary to get the wave past the district governor. With a differential type of governor there is no difficulty; for, as we have seen, the governor responds at once to any increase of inlet pressure giving a similar increase to its district. The constant pressure type, however, prevents variation of inlet pressures affecting the district. We must, therefore, have an attendant at the district governors to let the wave through, or else use some auxiliary long-distance system for automatically increasing the load.

The loading of station and district governors may be accomplished in a variety of ways—by weights placed directly on the top of the bell or on the arm of a counterbalance lever, by the weight of water, by the inlet gas pressure through a small auxiliary governor, or by air loading; the two latter methods, along with the use of the electric current, being suitable media for loading from a distance. The method of loading by water has much in its favour, as the load is very gradually increased or diminished, and automatic means are available to prevent over or under loading. Solid weights are often preferred to water weight, as the attendant can be instructed that, at certain hours, so many weights must be put on. This also gives the step-by-step system of pressure control where the alteration of pressure is wanted at once without waiting for the water to fill up. As already mentioned, when showing you the slides on the screen, there have been several methods introduced for automatically increasing or diminishing the load, and therefore the outlet pressure, according to the demand for gas. Time will not permit of my going into these in more detail; but the numerous arrangements indicate that nearly every requirement of pressure control that can be desired has been met and is available for special purposes.

Oscillation sometimes forms a difficulty with governors in certain places, due usually to sudden impulses given to the gas in the mains—through, for example, the draw caused by gas-engines. The trouble is usually found during small consumption when the valves are nearly closed. The disturbance in the main may increase the pressure momentarily, closing the governor right up. The consumption continuing, the pressure drops and the governor opens; and if it does not respond quickly enough, the pressure drops more than can be made up without the valve opening beyond its normal for the average consumption—only to be again closed, due to the rush of gas filling up too quickly. Each time the action becomes more pronounced, until a regular isochronous movement is set up, and is promoted by the elasticity of the gas itself. In such instances, a simple damping or cushioning of the bell can usually be arranged without interfering with the sensitive working of the governor.

CONSUMERS' GOVERNORS.

I now come to consumers' governors, and think the subject should provide much room for discussion, both as to the type of governors to use and their application in special circumstances. I hold that we shall not perfect our gas supply until we are able to give every consumer a steady pressure; and this is the opinion also of many eminent gas engineers. If we could do so without the introduction of fresh apparatus, and thus keep the distribution arrangements as simple as possible, so much the better; but

I am afraid that there are conditions which we cannot overcome except by introducing some automatic control at or near the consumers' premises. The question is one largely of expense and whether it will pay in the end to secure for our consumers the highest efficiency in their consumption of gas.

Mr. Charles Carpenter, the Chairman of the South Metropolitan Gas Company, in the discussion on Mr. Price's paper read before the Southern District Association of Gas Engineers,* made some striking remarks, which I should like to give you. He said:

> The ideal condition in gas supply is to give a uniform pressure to every consumer at his meter. . . . He had, therefore, reluctantly come to the conclusion that what would be done on a large scale before many years passed would be in the application of governors to the consumers' services. He had reluctantly come to this conclusion, because it was clear to anyone who had considered the matter that the expense of doing this would be considerable. . . . As had been pointed out, the incandescent burner (and especially the inverted burner) was more sensitive than any other forms to variations in pressure. . . . Cooking by gas was ideal with the conditions uniform. A cook ought to know exactly the time it should take to do a certain amount of work all the year round.

The governors suitable for consumers are of two kinds—viz., constant-pressure and volumetric governors. In the case of the pressure governor, the action is precisely the same as that of the station governor—a constant pressure with a variable delivery; so that whether one or more burners are in use all are supplied with gas at the same pressure. With the volumetric governor, quite a different action takes place, and we get a constant delivery at a variable pressure and within certain limits, whether the number of burners or the size of the orifice varies.

The first diaphragm pressure governor, or "moderator," as it was termed, is referred to by Mr. Peckston in his "Treatise on Gas Lighting" in 1841. It has a diaphragm pressed upwards by a spring against the outlet pressure which opened or closed a valve according to the demand for gas—thus keeping the outlet pressure constant. The first volumetric governor appears to have been invented in 1847 by Mr. John Leslie, and was called the "Automaton Gas Economizer." These governors both showed great original skill and ingenuity, and have pointed the way to later inventors.

The principle underlying the action of the volumetric governor is that the disc, or "float" as it is sometimes called, moving without friction in a cylindrical chamber, floats between two gas pressures. When the gas is first admitted, the disc rises momentarily to its highest point, closing the valve until the gas passing through side holes enters the chamber above the disc, which is then between two equal pressures. The weight of the disc then causes it to fall, but only until the weight of the disc *plus* the pressure above it, which is then reduced owing to the gas passing to the burners, equals the initial pressure. The difference of pressure below and above the disc continues under all changes of initial pressure, and the pressure at the burner is kept constant, varying only when the aperture or injector of the burner is varied; but the quantity of gas remains uniform under all pressures. The disc rises and falls as the inlet pressure varies; thus opening and closing the outlet from the tube in the disc through which the supply to the burner is conveyed.

Their Proper Application.

Having described the action of the two types of consumers' governors, we may now consider their application. For small installations, where the premises are properly piped for a good supply of gas to the fittings in use, a single pressure type of governor at the gas-meter will suffice in most cases. Where, however, the piping is too small, the full pressure may be required for the majority of the fittings, in which case individual governors should be used for any fittings where the pressure appears too high or is irregular, and affects the proper combustion of the gas. For example, a gas fire or a cooker may be taking away all the pressure from the remainder of the fittings, in which case no governor is required at the meter; but a volumetric governor on the fire or a pressure governor at the cooker (to deal with the varying number of burners at times in use) might be put on with advantage.

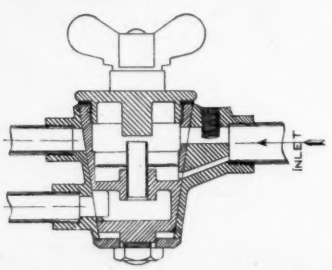
In large installations, it is often the best practice to divide up the piping of the premises, placing pressure governors at branch pipes, and allowing the full pressure to pass to the remainder of the building; individual governors being placed on special appliances where a further control is advisable, so as to deal with the different pressures best suited for each piece of apparatus.

The incandescent light for domestic use gives in most burners an excellent result at from 20-10ths to 25-10ths pressure, burning with fair efficiency free from noise and without smoke. Gas fires and cookers and engines, on the other hand, usually work best at pressures about 12-10ths or 15-10ths. If we can keep our pressure or consumption constant, the alteration of the air gives us a fair means of adjustment to practical and efficient results.

I am not one to advocate anything that would hinder progress; and consumption pressures seem to be advancing. But I think we have reached a stage when a tentative standard might be adopted, so that our appliances could all be made for the same pressure. I think that if (say) 25-10ths or 30-10ths were adopted as a moderate standard pressure for a few years, we should at least be improving matters considerably.

Volumetric Governors.

With your permission, I will now describe two new volumetric governors which will, I think, be of considerable assistance in connection chiefly with gas-fires. The principle is not new, but I believe the arrangement is quite novel. The volumetric governor, as has been said, deals with a definite quantity of gas, irrespective of changes in the inlet pressure, and whether the orifice is large or small. If, then, a volumetric governor, as hitherto constructed, is fitted to a gas-fire, and we turn down the tap so that less gas than that for which the governor is set is passing, the governor is put out of action; and changes of inlet pressure then affect the fire in the usual way. By this new arrangement, the stopcock of the fire is attached to the governor in such a manner that when the tap is turned to lower the gas, the governor remains in action—giving a constant supply at the reduced setting against all changes of initial pressure. A governor for a duplex fire has also been constructed on the same lines, so that first one set of burners may be gradually extinguished and then the remainder lowered; and the consumption remains constant after each adjustment of the tap, irrespective of changes of inlet pressure. In both of these governors the further turning of the stopcock shuts the gas completely off in the usual way.



Gas-Fire Governor, with Regulating Stop-Cock.

There are two small points I should like to mention in connection with volumetric governors. The first is the supposed loss of pressure at the point of ignition. The majority of these governors require from 4-10ths to 5-10ths to operate them; but provided we have this excess pressure over that which the injector alone requires to pass its quantity, the governor will come into action, and pass the volume of gas for which it is set. If, then, when the governor is in use the correct quantity of gas is passing through the injector, there must be the pressure behind it (that is, at the point of ignition) to force it through. The other point is in the comparison of the size of the volumetric governor with the pressure governor for similar consumptions. The disc of the volumetric governor is moving between two very nearly equal pressures; whereas before we can get the pressure we want from a pressure governor, the diaphragm or bell must be loaded by weights. These have first of all to be lifted by the gas before we reach the point at which the differences of pressure become available for moving the diaphragm or bell. And, again, there is a certain portion of the diaphragm where it is held by the casing, and forms a hinge, so to speak, which is non-effective. Thus we require for the pressure governor a much larger diameter than is necessary for the volumetric governor, which often puts its application, where appearances must be studied, out of the question.

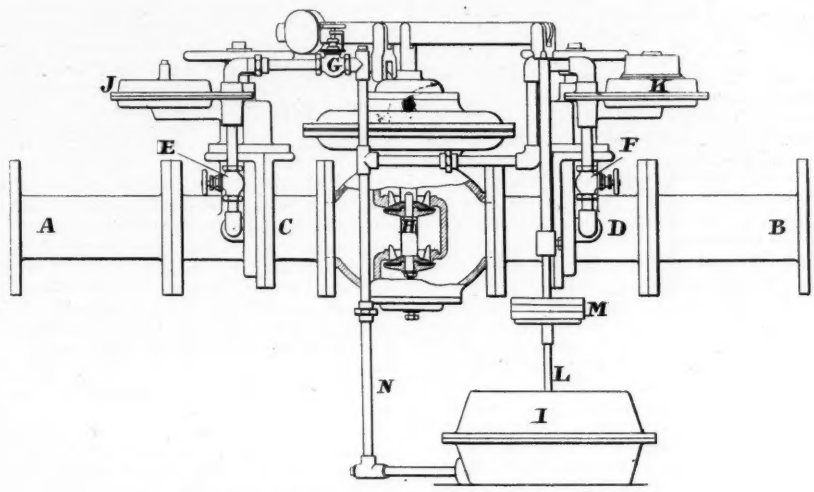
High-Pressure Governors.

I shall now deal very briefly with the subject of governors for what we term "high-pressure gas." It seems a pity we do not adopt a definite method of describing high or low pressures. Ten inches is high pressure when compared with ordinary pressure of 20-10ths or 30-10ths. just as 60 inches is high in comparison with 10 inches. I think by "high pressure," however, we at present mean gas in the neighbourhood of 60 inches water-gauge. For many years compressed gas has been used in this country for railway carriage lighting, lighthouse work, lighted buoys, &c., but for general illumination purposes its application is certainly of more recent origin.

America, with its vast fields of natural gas, has led the way in the matter of high pressures for ordinary gas supply, and special governors had to be brought out to deal with the conditions. The gas is pumped up to many pounds pressure per square inch, conveyed in small steel mains over miles of country, and then distributed and consumed at high or ordinary pressures.

By the kind permission of the Bryan Donkin Company, I will show you a diagram of the Johnson-Reynolds district governor for reducing the pressure to any desired extent. It is a very ingenious arrangement. The main governor H acts similarly to other pressure governors previously described, the diaphragm opening or closing the valves, and thus keeping the outlet pressure steady through varying consumptions or alteration of the inlet pressure. The method of loading is through a lever and rod L, upon which the weights are placed, the lower end of the rod being attached to a diaphragm in an auxiliary chamber, or, as it is called, pressure bowl I, the object of which will be seen in a moment. There is besides an auxiliary system of piping, controlled by two small high-pressure regulators as follows: The first of these governors J receives the full inlet pressure, and delivers it reduced as desired through the needle valve G to the under side of the diaphragm in the pressure bowl, and at the same time to the second auxiliary governor K, which may be set to deliver gas at the same pressure as the main governor into the low-pressure

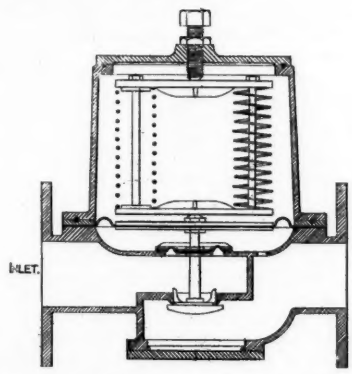
* See "Journal," Vol. CXII., p. 477.



Reynold's Patent High-Pressure District Governor.

main. There are two useful objects gained by this auxiliary system—first, the auxiliary governors will deal with the minimum consumption, the main governor being shut off, and, secondly, a powerful pressure is obtained to close-off the valves, both of the main and auxiliary governors, when there is no consumption. When all consumption is shut off, the second small governor closes, and thus locks-in the gas flowing slowly through the needle regulator to the under side of the diaphragm in the pressure bowl until the pressure builds-up to that at which the auxiliary governor is set—thus bringing a heavy upward pressure on the rod and lever, forcing the main governor valves home tight. Without undue size, it is easy to obtain sufficient leverage and diaphragm power to shut off the auxiliary governors too; so that a perfect result from the system is obtained.

Small governors of the type used in the auxiliary system are suitable for delivering a supply direct from the high-pressure main to consumers. The patent records give ample illustration of those that have been in use for many years in connection with high-pressure gas for railway-carriage lighting, &c., as already mentioned; while other forms have been introduced. [The author showed one or two on the screen.]



Diaphragm Governor with Multiple Spring.

We have also to consider a governor to give a high outlet pressure in order to get the advantage of high pressure for lighting and industrial purposes. It is purely a question of loading; but at the same time this becomes a somewhat difficult matter. A governor with a diaphragm 10 inches diameter requires a load of about 157 lbs. to give 54 inches pressure. This may be obtained by a long lever and weights or a powerful spring, provided in the latter case that the valve movement is small, so that the alteration of the length of the spring due to the movement does not vary the load to any extent. A simple arrangement of multiple springs is shown, which allows of a fairly large movement of the valve without alteration of the tension, and is in a handy form for convenience and nicety of adjustment.

[The author concluded by showing a few simple experiments.]

(III.)
SOME NOTES ON LIGHTING APPLIANCES.

By S. B. Langlands, of Glasgow.

This short paper will be thought to be trifling, yet how very much of "our daily round, our common task" is made up of details and trifles? There is a Scotch injunction, "Look after the pence and the pounds will take care of themselves," which I read: Attend to small matters, and as a natural sequence the seemingly great matters become easy. Gas engineers in many of our towns give little or no attention to the details necessary to ensure efficient lighting in the streets. If you ask them why, you may get the answer that the public lighting is not under their care. To my mind this answer is not sufficient. If they supply the gas, it is their bounden duty to see that the highest efficiency is got from it for their own credit's sake. The very worst advertisement gas suppliers can have is badly-lit thoroughfares. In many places which I have visited one finds the glass of lanterns only half-cleaned, the reflectors filthy, and the burners and mantles uncared for and ill-kept. If the smallest amount of regular attention were given to maintenance, one would hear less of the conversion of street lighting from gas to some other method. This is my reason for giving these notes on points which have cropped up with street lighting.

Burners.

Recently an excellent series of articles appeared in one of our technical papers on "Gas-Burners." Quite possibly some things said in the articles may be repeated here. If so, then we have come across the "detail in our daily work." The upright Kern burners are still commonly used; and I think it may not be amiss, therefore, to deal with the handling of them. This type of burner has been a splendid one for street lighting; but it requires an immense amount of care—in fact, I know no burner that requires more attention. It must be regularly taken apart—the inner cage and the saw-cut disc brushed out and cleaned, and the nipple cleared. When the burner is being put together again, there has always been a difficulty in getting the top of the disc exactly centred. If it is not centred, a bad flame, and therefore a badly-filled mantle, is the result. So much was this the case that I wrote the Welsbach people some years ago asking them to put guides on the cage just below the disc; but they did not adopt the suggestion, though quite recently when I mentioned the same point to the makers of a similar burner they at once saw the force of the suggestion and adopted it.

Some time ago experiments were made by us as to the relative value of the inverted burner and the Kern burner, which we were using almost entirely in our streets. As a result of our tests, we obtained an efficiency—a maintainable efficiency—of 18 candles per foot with the Kern burner, as against 21 candles per foot with inverted incandescent burners; so that now we are slowly changing from upright burners to inverted. As a result of a number of tests with various kinds of inverted burners, we are fitting a swan-neck made to suit our special conditions. Exhaustive and elaborate series of tests were made to determine the correct size of gas-nipple, the area of air-ports, and the length and diameter of nozzles. It was interesting to find how much these points contributed towards a perfect burner; and we have now a range of standardized burners suitable for Glasgow gas for consumptions from $1\frac{1}{4}$ cubic feet up to $3\frac{1}{2}$ cubic feet. Swan-necks are being used just now, because with them the light can be got in the centre of the lantern. Although this burner has been chosen, it is only a temporary choice, because the burner pendant from the centre of the reflector—the gas supply pipe being led up the astragal of the lantern—is preferable, and we are giving this matter our attention just now. The trouble is to get the reflector so shaped and pointed and the burners of such a make as will allow the light to be, like that of the swan-neck, in the centre of the lantern. Still, I hold this can be done; and I hope at an early date to be able to submit a lantern meeting the points.

A curious problem arose, and was dealt with by us recently. There are a dozen lamps on the parapets of one of our city bridges. Almost half of the light from these went to the river; so we set about getting the light sent in the direction where it would be of use. One of my assistants (Mr. Le May), after many talks, got reflectors made, much like the wings of a butterfly, only the wings were concave, and at the junction of the wings were two inverted burners fitted side by side. This had a so distinctly novel appearance that I "funked" putting it in position for some days.

Afterwards I found my courage; and the result was so satisfactory that the other eleven lanterns are now being made up in an entirely similar manner, and will be fitted up in a month or so. I am so convinced of the aid which reflectors are to lighting that many of our present experiments are being made along this line. The coming of the inverted burner has brought its own problems and useful diffusion and reflection of the higher intensity of light, gained, as against that obtained from the upright burner, is not the least of them. It may be that some reflector will require to be put in the bottom of the lantern to catch up the falling rays and send them out on the horizontal plane.

Mantles.

The necessity of getting mantles of the right texture and right shape to suit the flame obtained must be urged. So much was this so with the old Kern burner that, after a number of tests made with our gas and the volumetric governors in use, we prepared a gauge for controlling the length of pin to be used; this gauge being given to every one of our employees. It is possible to get so heavily a woven and impregnated mantle and so slow a flame that the resultant light is of the very lowest efficiency. The nature of each flame must be studied, and the mantles chosen accordingly. Then the diameter and the length of the mantle have to be watched very carefully. This is particularly the case with the Kern burner. If the mantles are too wide, they dance in the flame, then cut off round the top of the burner. If they are too long, they stick on the shoulder of the burner, and the figure for mantles used goes up accordingly. With the swan-neck burner which we are using, we are trying a new two-pronged mantle hung on projections from the nozzles; the prongs being knife-edged or rounded so that the mantle always keeps vertical by its own weight. Might I here again remark that it is not wise to save mantles at the expense of the lighting; and the fanciful figures given of low mantle consumptions often spell "frayed, broken mantles on the streets."

Glassware.

Some interesting data were obtained by us some years ago when we were looking for a protector glass for the Kern burner. Six years ago, each protector glass lasted on an average for one month. Now they last for one year. Of course, in passing, it must be remarked that when a funnel came down it often brought the mantle with it. It was, therefore, worth while looking for a better glass. First American glass was tried, and found to be an improvement, but too dear to warrant its use. Next a German glass was got, which had a long life but fogged very badly. Then an English firm sent in a glass. So the tests went on; the prices coming down bit by bit as a result of competition. Finally, a glass was got giving a life of almost 400 days, as against 30 days of the original inferior chimneys, and the cost to-day of the good funnels is only what was paid six years ago for the inferior glass. This same system of elimination was done also with mantles.

[The author appended four sheets of tables showing the number of mantles and the amount of glassware used in the Corporation lamps during the month of July. From these, it appears that there are 19,841 incandescent burners in the various divisions of the city. During July, 15,928 "Kern" mantles were used, compared with 13,863 in July, 1911—an increase of 1065. The average number of mantles used per lamp varied between 0·56 and 1·18. The funnels used during the month numbered 1081; being 84 less than in the corresponding month of 1911. The average per lamp varied between 0·04 and 0·07 In addition to the above, there were 4530 incandescent burners throughout the city in which "swan-neck" mantles are used. These required 2319 mantles, compared with 2143 in July, 1911. The average per lamp in this case varied between 0·35 and 0·65—an average of 0·51. Throughout the city, there were 35,476 incandescent burners used for stair lighting; and these during July required 6719 mantles, or 0·19 on an average per lamp.]

Lanterns.

In the making of lanterns for street-lighting purposes, there are one or two details to which particular attention must be given. The lanterns should always be made of copper; the frame of the lantern where the astragals and the bottom and head spars join should be specially stiffened, and the tops of the lantern should be hinged on to permit of the easy fitting of reflectors—a chain being attached inside to prevent the top being opened too much. Standardization of all the parts should be aimed at, not only in case of replacement, but to simplify the glazier's work. Any pane of glass for a lamp should fit all lamps of that size. Have no frills on the top of your lanterns, because behind this sort of ornamentation the city's dirt usually finds a resting place. Lanterns must of necessity be wind-proof and storm-proof. By storm-proof is meant rain-tight during the fiercest gale. Remember that the glazier can have a big or little bill dependent on his glazing methods, Catches pressed down too tightly against the panes, or panes slightly too large, prevent the expansion of the glass when the lantern is in use. Try and get a good heat-resisting paint for your lanterns, as few things look uglier than street-lanterns peeling and shedding their paint. Another ugly thing often seen is paper street name slips on the panes almost rubbed off. To overcome this, panes are now made at a very small cost having the street name burned in in colour—say, blue on a white ground—and this resists the efforts of the most vigorous lamp cleaner. Do not fit enamelled iron reflectors in your lanterns, but use real porcelain of the best quality only, and remember to allow for expansion and contraction here also. Provide your lamplighter with a chamois leather and linen duster for his cleaning, and see that he uses them. As I said at the outset, going about from town to town, I have been disgusted to see the filthy state the public lamps are allowed to get into. Try and remember that, as has been reiterated over and over again, town lighting should be your best advertisement, the which, alas, it too often is not.

As I have already said, this may appear a trifling record; and if my gas engineer friends cannot find anything novel to them, perhaps it would pay them to hand a copy of this paper to their subordinates who are dealing directly with these matters, also to the chief constables and other municipal officers who look after public lighting, in the hope that they may find something at least suggestive. To show my own interest in this matter, I may say we are at present equipping a complete laboratory, so that we can determine for ourselves what is best to use in the lighting of the city.

Discussion.

Mr. A. Yuill (Dundee) in opening the discussion on the preceding papers, said that all of them had been of an instructive nature, more especially the one dealing with public lighting, Referring to dual control, he thought that gas managers ought to make every effort to get greater control in public lighting, because there was no one who knew better about the economical uses of gas than the gas manager did. The sooner the Town Council of Broughty Ferry allowed Mr. Keillor to exercise his inventive genius, the better it would be for the place. He did not think, from experience, that the combination of pressure-wave and clockwork would command many votaries, because anyone who was in a position to utilize the pressure-wave got all he required from it. But for those who could not take advantage of it, clockwork was at their command; so that he could not see where dual control by pressure-wave and clockwork was to be advantageous. He had tried various pressure-wave controllers; but, owing to the exceptional circumstances under which he was placed in regard to altitude and to the local consumption, he could not take advantage of this form of lighting. The first consideration, when dealing with the clockwork arrangement, was the question of superiority in the mechanism; and this could only be found out by trial. In Dundee last year, they put in 1000 clock controllers—one-third of each of three makes; and after a year's experience they decided to put in another 2000. This gave them 50 per cent. of their lighting under the clockwork arrangement. Possibly in another year or so they would have the whole system completed. The total cost had worked out at a lower figure than Mr. Keillor had given; but this might be caused, to some extent, by the installation of new lamps being required. With reference to the paper by Mr. Peebles, he might say that after two years' use of high-pressure gas he had nothing but praise to give for the way in which the governors worked. Mr. Langlands had given the members a good deal of information; but they were more concerned about the inverted incandescent lighting. Unless they had the circumference of the mantle in the zone of the flame, they could not get the maximum amount of light; and this could only be determined by taking the height best suited for it.

Mr. W. R. Herring (London) said the members would all agree that the automatic lighting of public lamps was an ideal that should be striven after. The pressure-wave system was undoubtedly the more preferable. A few years ago, he had occasion to examine and inquire into the various devices then upon the market, and the trouble with which he was confronted was the question of cost, or rather saving. He did not hesitate to spend money if he could see a proper return from it; but when they were dealing with burners that were using 2¼ cubic feet per hour, and they had to allow for a pilot-light consuming a minimum of about ¼ cubic foot per hour, there was a large percentage of gas practically unused in order to save the expense of lamp lighting and extinguishing. At the price at which the apparatus was then sold, he came to the conclusion that he would require five years' savings of lamplighters' wages to pay for the installation; so that at that time he did not consider it advantageous to apply the system. With reference to Mr. Peebles' paper, what was considered sufficient in the old days was not sufficient now, because the method of burning gas was so influenced by variations of pressure that refinement in apparatus, both scientifically and practically, was a necessity. He had found that by increasing the pressure, and thus the consumption, the efficiency was increased in the same ratio. The question of domestic governors was a moot point. More waste and more discredit was brought upon heating by gas through wasteful consumption owing to changes of pressure than anyone could possibly imagine. Mr. Peebles' apparatus could not be very costly; and they ought to determine to adopt it, or a similar type, and give the necessary instructions to consumers, so that they might learn to use gas economically for heating purposes.

Mr. W. F. Vernon (Stonehaven) said that in his town they could claim to be one of the pioneers of public lighting on the pressure-wave system. It had been in use for six years, and had given every satisfaction. A feature of the installation was the freedom from breakage of mantles. They lit for nine months in the year; and the average number of mantles required for each of the automatically controlled lamps was only three. One trouble was that when they put on an extra 20-10ths pressure it

caused hissing and roaring of the gas in public buildings, and sometimes broke the glass in consumers' houses. In order to counteract this, he had recommended the use of domestic governors; but consumers had been very tardy in adopting them. In time, however, he thought the matter would rectify itself. There had been no reduction in the cost of lamplighters' wages in Stonehaven, because the Town Council started with the system in the outlying districts, and were gradually working in towards the centre of the town.

Mr. J. B. Scott (Cowdenbeath) expressed the opinion that if they had a good system of automatic lighting it relieved them of a squad of lamplighters, which to a certain extent obviated labour troubles. Mr. Keillor's system of pressure-raising was a model one. With reference to Mr. Peebles' paper, he said the point that appealed to him most of all was the one dealing with consumers' governors. What they should look forward to was to have maximum pressure on the mains, and a governor on every meter, so that each consumer could have exactly what he wanted.

Mr. S. B. Langlands (Glasgow) could not recommend pressure-wave lighting in Glasgow. If pressure lighting was adopted, they might have general failure; but with clockwork controllers there could only be unit failure. This was a very vital question in a big city. He was not an advocate of the tremendous mantle-saving cry. They could save mantles at the cost of their light; and this was far too often done. Let them take down their mantles when they were exhausted, clean their burners, and keep them in an efficient state. Their gas lighting in the streets was drifting away from them, and they did not see it. Their street lighting was, and always would be, their very best advertisement. Governing was the only absolute cure for gas-fires hissing.

Mr. A. H. Rule (Kelty) said that in his town they had 120 lamps in their system, which were fitted with automatic controllers. His two years' experience of the system certainly did not lead him to believe that it was a panacea for all ills. Still, while there were undoubtedly a great many objections to it, he was satisfied that it was a considerable improvement upon the ordinary hand lighting. In Kelty, they had to supply a small district about three miles away; and to do this they had put in a boosting plant. The system, however, was of no use unless the lanterns were absolutely good, and fixed securely to the lamps by cast-iron frogs. They had a sort of cradle on which the lantern rested, and this caused considerable vibration, which was anything but helpful to the system. Not only so, but upon windy nights he had seen several of the lamps, after being put out, burning in the morning because of the wind having blown-up the controller. To his mind, the system would never reach perfection until they were able to do away with the bye-pass. If they could find some means of igniting the gas without this, the system would be an ideal one.

Mr. Keillor, replying to the discussion, remarked that, Mr. Langlands being such a progressive lighting inspector, he ought to "go the whole hog," and be done with it.

Mr. Peebles also briefly replied.

(IV.)

A YEAR'S WORK WITH VERTICAL RETORTS.

By W. Blair, of Helensburgh.

Somewhat rashly, I at our last meeting promised to give you the results of my first year's experience of vertical retorts. I say "somewhat rashly," for the year's working has been so uneventful that there is little to write a paper about—mere figures of results being but lifeless. However, being committed, I have tried to make the best of it, and trust the information produced will be of interest and use to you.

Perhaps in the beginning it would be well for me to refresh your memories with a short *résumé* of the description of the plant given at last year's meeting. In the Helensburgh installation of Glover-West vertical retorts, there are two settings of eight retorts each, having a nominal capacity of 500,000 cubic feet per day. These are so arranged that they can be worked in units of two. The retorts measure 20 feet long, tapering from 30 in. by 12 in. to 36 in. by 21 in., and are built in sections of 1 ft. 11¾ in. each.

Each setting is provided with a twin producer; thus providing for economical working when on the minimum make. The fuel gas goes up a vertical flue, with ports at equal distances in its length, through which gas passes and meets secondary air. There are eight of these combustion chambers in the vertical length of the retorts, each of which is separate from the other; and with the aid of dampers at each port, it is easy to regulate the quantity of heat at each section of retort. The secondary air is made to pass round the cast-iron base of the retort; thus conserving the heat of the coke, and assisting in its being discharged in a cool state. After passing round the retorts, the waste gases enter a common duct exterior to the combustion chambers, and circulate through chambers situated at the two top ends of the retorts before entering the chimney.

During the year, all classes of coal—from triping, single, double, and treble nuts, unscreened and screened coal, splint, coking, and even cannel coal—have been passed through the retorts with satisfactory results. We have had practically no difficulty in carbonizing any class of coal; it being only necessary to watch the speed of carbonizing when changing from one class of coal to another. A dull coal may succeed a coal which gives up its gas freely; thus at the same speed of carbonizing causing greenness in the coke discharged. However, a reduction in speed soon puts it right.

With the highest class of coking coal there has sometimes been a tendency to hanging-up at the top; but generally a push with a rod through a hole in the safety ball at the top of the retort has been sufficient to move it. We have been very free from serious hangs-up of this sort. On only one or two occasions has it been rendered necessary to stop the extracting gear and wait till the coals at the top were sufficiently carbonized to be easily moved down with a touch of the rod.

During the coal strike, we purchased 150 tons of second-class cannel, which was used in the proportion of one of cannel to two of ordinary coking coal in stock. They worked very well together, giving us a fairly high hourly make of gas; and when discharged it was almost impossible to distinguish the cannel coke from the ordinary coke.

The quality of the coke is much improved over that obtained from the old horizontal retorts. It is much larger and denser, and has a beautiful silvery appearance. Leaving the retort in a cool state, it does not require quenching, and is therefore much lighter. For all manufacturing purposes its value is much enhanced, and it commands higher prices.

The yield of tar and liquor shows a large increase over anything ever achieved with the old horizontal retorts. Over the average of the old bench, the increase of tar and liquor is almost 30 per cent.; the liquor being of equal strength—5° Twaddel. The tar is much thinner. A recent analysis gave the following results:—

	Per Cent.
Distillation products, 0° to 170° C.	4·0*
Tar acids	4·2
Carbolic acid	*nil*
Paraffins, 170° to 270° C.	18·9
Heavy oils, 270° to 350° C.	11·3
Pitch (very soft)	62·0

*Composed of water, 1·7 per cent.; and oil, 2·3 per cent.

The retorts, after fourteen months' work, are in good condition, and seem likely to run for a long time. Of course, it is too early yet to say anything really definite regarding the durability of vertical retorts; but I believe that their life will be much longer than that of horizontals.

The results and working costs of the verticals for the full year, along with the average results of the old horizontal bench, are given as under—

	Vertica's.	Horizontals.
Coals carbonized	5,779 tons	6,201 tons
Gas made	68,755,000 c. ft.	59,902,000 c. ft.
,, ,, per ton	11,897 ,,	9,498 ,,
Tar and liquor sold	365,400 galls.	306,000 galls.
,, ,, ,, ,, per ton	63·16 ,,	49·3 ,,
Coke sold	2,621 tons	3,304 tons
,, ,, per ton (dry)	9·08 cwt.	10·65 cwt.
Coke used as fuel per 100 lbs. of coal carbonized	17 p. c.	29·5 p. c.
Cost per ton from coal-waggon to coke yard	1s. 6·2d.	2s. 4d.
Cost per 1000 cubic feet sold	1·64d.	3·14d.
Cost per ton for power and maintenance of coal breaking and elevating plant	0·39d.	..
Do. of coke-extracting plant	0·95d.	..

It should be noted that our stoker is a versatile sort of person, as he also looks after the exhauster engine, fires the boiler, and attends to the scrubber pumps. Further, since April we have had four men doing the work of only three, as we have two men on the 10 p.m. to 6 a.m. shift, against one on each of the other shifts. This is necessary, as it would be unsafe and unwise to have one man only in the works throughout the night.

Over the year, the average illuminating power of the gas equals 15·66 candles. The average calorific value, as taken by a Beasley recorder over long periods, is 549 B.Th.U. net.

In conclusion, let me say that we are well satisfied with the results obtained, and believe that, with increased knowledge, we will be able to further improve on them.

Relative Corrosion of Iron and Steel Pipe.—This subject was dealt with by Mr. W. H. Walker in a recent number of the "Journal of Industrial and Engineering Chemistry." According to an abstract in the "Journal of the Society of Chemical Industry," samples of pipes were taken from hot and cold water feed systems, from live and exhaust steam lines, hot-water and steam-heating apparatus, &c., in which wrought-iron and steel pipes had been used together; and the two kinds of pipes were examined as to relative durability by cleaning from scale and rust by means of ammonium citrate solution and then measuring the ten deepest pits per unit distance of length. Taking 64 different cases, it was found that in 17 cases the corrosion of both iron and steel was negligible; in 20 the iron was inferior and in 18 superior to the steel; and in 9 the corrosion of the iron and steel was about equal. Incidentally, it was confirmed that practically no corrosion takes place if oxygen is excluded from the water, and that the so-called "acid corrosion test" (the exposure of the metal to 20 per cent. sulphuric acid for four hours) is worthless for the purpose of judging the durability of iron or steel under service conditions.

PROGRESS OF INDUSTRIAL CHEMISTRY.

The Engineering Supplement to "The Times" last Wednesday contained a full abstract of the Inaugural Address of Dr. RUDOLF MESSEL, F.R.S., the President of the Society of Chemical Industry, at the annual meeting, which was held last week in New York, and was followed by the Eighth International Congress of Applied Chemistry. The following are the portions of the address most closely connected with subjects in which "JOURNAL" readers are interested.

SYNTHETIC PROCESSES THE KEYNOTE OF PROGRESS.

The President began by remarking that the introduction of synthetic processes might be said to be the keynote of progress of modern industrial chemistry. One of the most fascinating compounds recently introduced into industry was calcium carbide. It had lain dormant since its discovery in 1862 by Wöhler, until Willson and Moissan made use of the electric furnace to produce it. Now its manufacture constituted a mighty industry; close upon 300,000 tons being produced annually. Serving as it did as raw material for the manufacture of calcium cyanamide, it was the parent of numerous other products of great importance. Among these might be mentioned acetylene, so largely used as an illuminant and for welding and cutting metals; and the possibility was foreshadowed that this gas would be of use as the starting-point in making other chemicals. Calcium cyanamide, apart from its undoubted great value as a fertilizer, was coming to the fore as a source of cyanides, now so largely used in extracting gold. What might be of far greater importance, it was convertible by the action of superheated water into ammonia, which, in turn, might be converted into nitric acid and nitrate of ammonia by oxidation with air under the catalytic influence of platinum.

THE PRODUCTION OF NITRATES.

If he had laid stress on the conversion of ammonia into nitric acid, the reason was that ammonia was obtainable locally everywhere as a bye-product of the manufacture of illuminating gas or Mond gas and from coke-ovens, and that the installation for converting it into the acid was a relatively cheap one. The numerous attempts to produce ammonia synthetically from its elements (nitrogen and hydrogen) or from various nitrides, such as those of titanium, boron, magnesium, aluminium, and calcium, could, moreover, only be of benefit in solving the problem. True, the direct production of nitric acid by means of the electric arc from atmospheric air might appear to be a more rational process; but so long as this industry was tied to water power, and the difficulties of transporting nitric acid as such in aluminium or iron packages were not overcome, the case seemed different, in his judgment, particularly in countries where water power was not available, and other power was as yet too expensive.

He had referred to the production of these compounds of nitrogen on account of their importance in agriculture. Food the nations must have, and it seemed that to this end they would require the services of the chemist more and more as population grew. The great stimulus Sir William Crookes had given to the production of nitric acid, by calling attention to the near approach of the exhaustion of the deposits of nitrate of soda, was well known; and he was pleased to point out that America was the first to attempt the realization of this great problem. The realization of the other problem—*i.e.*, the production of ammonia from its elements—appeared likewise on the eve of accomplishment; and he hoped it would not be long before details would be available of the manner in which it had been solved in practice, and how the great technical difficulties had been overcome.

ALUMINIUM.

The application of aluminium as a fuel by Goldschmidt had led to the production, by his alumino-thermite process, of many metals in a relatively pure form, otherwise only producible by the agency of the electric current. Chromium, manganese, and molybdenum prepared by this method, besides various alloys of nickel, iron, and copper with these metals or with titanium and vanadium, had found a use mainly in the iron industry. The ingenious process of welding rails and repairing castings by means of the thermite process was, of course, known to all, as well as the use of tungsten and tantalum as filaments in electric incandescent lamps. The mention of tantalum might recall the fact that the expression "rare" had fallen into disuse, as the earths once known as rare were in everyday use; and, owing to the scientific acumen displayed by Dr. Auer von Welsbach, the gas industry was now well able to hold its own against the electrical industry. But electricity was in evidence everywhere in chemical industry. It had threatened to displace the furnace in the alkali works; it provided chlorine; and the time might not be distant when muriatic acid was made electrically. Chemists were indebted to the electric furnace for the sodium industry (with its application to the cyanide, sodium amide, and other manufactures), and for the production of ferrosilicon, carborundum, and graphite, for which, in the form of electrodes and of lubricants, America, thanks to Mr. Acheson, remained as yet unsurpassed. The manufacture of nickel by the remarkable Mond carbonyl process should not be forgotten. This metal would appear to have some future in the elimination of carbon bisulphide from coal gas, and possibly as a catalytic in other industries. Another class of industries, the influence of which had been momentously important industrially, and had acted and reacted greatly on science, comprised dyestuffs and synthetic organic products, including drugs. It was noteworthy how, from the outset, the establishment of new industries, based on the discovery of aniline dyes, and of methods of producing alizarin and indigo artificially, had in turn given rise to many others, as the organic and inorganic chemicals they required, which were little, if at all, known to commerce at the time, had to be produced on a large scale. Benzol, nitrobenzol, aniline, to mention only a few, were among the newcomers; later on came anthracene. The coal tar industry was now the largest consumer of inorganic products, and was the cause of the invention of the catalytic process of manufacturing sulphuric anhydride.

THE EDUCATION OF THE TECHNICAL CHEMIST.

The list of chemical industries dealt with and their great variety suggested the question, Could a chemist be so trained that on entering into any kind of works he would at once be of use and efficient, apart from the expectation that, as a matter of fact, he was supposed to be a proficient analyst? Dr. Messel's answer was in the affirmative, provided that the employer himself knew something about the industry in which he was engaged. In such a case, he would be patient, and would not expect too much from a beginner. If the student was but to know the chemical and physical principles which underlie so wide a range of activity as was provided by any one of the industries he had pictured, his time would be more than occupied. To expect him to be conversant also with the technical and economical aspect of industrial problems and to be able to apply his knowledge forthwith, was going too far. Technical training could be of real value only after a sound foundation in the principles and practice of pure science had been acquired. Could such technical knowledge be acquired by the student before entering into practice, as well as the scientific knowledge that would be of use to him and his employers in all or the majority of the industries which had been enumerated? Evidently it could not. And if so, was it worth the student's while to sacrifice much time at the most important and critical part in his life, so far as learning was concerned, in acquiring technical knowledge which might be of no assistance to him in after life? Experience showed that technique was very readily acquired in practice by one who had been scientifically trained. The most important task of the employer in industry, as in every other walk in life, was to find the right man; and the right man with scientific knowledge, who had imagination and power of observation and could select and command competent subordinates, was immeasurably more useful than the otherwise right man without scientific knowledge.

Another Petrol-Air Gas System.

A patent has been taken out for France by M. Bergasse for a system of lighting and heating based upon the supply to dwelling-houses of cold air which can be carburetted by the consumer and used for a variety of purposes. M. Bergasse has applied for a patent for England; but it has not yet been granted. When this is done, the invention will be noticed in the usual way in our "Register of Patents." Meanwhile, the following brief outline of the system is taken from the French specification, which has lately been published. The air is pumped into a holder at central works, then purified and cooled, to prevent condensation in the mains conveying it to the place where it is to be utilized. The mains may be made of an inexpensive material, as leakage from them would not be dangerous or cause any great loss. The carburettor or gas-producer can be placed either inside or outside the consumer's house. Where the gas is used for public lighting, the streets are divided into sections, each of which is served by a carburettor; but where the lamps are some distance apart, each can have its own carburettor. The chief advantages claimed for the system are that petrol is to be obtained everywhere at a cheap rate; that gas made by carburetting air with it is not noxious, and is equally suitable for lighting, heating, and motive power; and that its cost is from 50 to 75 per cent. less than coal gas.

American Briquettes.—According to a report by Mr. E. W. Parker, of the United States Geological Survey, considerable progress has been made in the development of fuel briquetting in the States during the past two years. The country, however, still lags far behind some European countries, particularly Germany, in this line of industrial activity. In 1909, the production of fuel briquettes in the United States was 139,661 tons—an increase of nearly 55 per cent. over 1908. The production last year being 212,443 tons, the increase in two years amounted to 72,782 tons, or 52 per cent. In Mr. Parker's opinion, more attention should be given to this industry, as on it depends to a considerable degree the utilization of some grades of fuel which are now wasted or sold at less than the actual cost of production. Twenty plants in the States manufactured compressed fuel in 1911—an increase of four over 1909; but four of the twenty were operated only in an experimental way or for demonstration purposes. Of the commercial plants, eight used anthracite as a raw material, two used bituminous coal, two used semi-anthracite, one used refuse from oil-gas works, one used peat, and two used mixed material. The manufacturers place their products on the market under special names, such as "boulets," "eggettes," "carbonets," and "coalettes."

MISCELLANEOUS NEWS.

ACCIDENT DURING MAIN-LAYING OPERATIONS.

A Workman Fatally Gassed.

Early on Monday morning last week, while some workmen were engaged in laying a new 18-inch high-pressure main from the works of the South Suburban Gas Company at Lower Sydenham to those at Bromley which have just been acquired by the Company, an escape of gas occurred in the Holmesdale Road, and before the men could get out of the trench five of them were overpowered. They were all promptly removed, and medical aid was summoned. Oxygen and artificial respiration were successful in restoring four of the men; but the other—Henry Sivyer, aged 36—unfortunately succumbed. An inquiry into the circumstances attending the fatality was held by Mr. H. B. Sewell, in the Municipal Buildings, Bromley, last Thursday, when Mr. F. Blyth (Messrs. Dutton, Hartley, and Blyth) attended to watch the proceedings on behalf of the Company.

The widow of the deceased man having given evidence,

Owen Martin, a general labourer, said he was at work in the trench, about 20 yards from the end of the main, when he heard a rushing noise, and saw a man jump out of the trench. He himself got out, and on looking round saw Sivyer trying to put the plug back into the pipe; but he could not do so. The gas was escaping with a noise like the wind blowing hard; and the plug was blown out of Sivyer's hand.

Walter Wheeler, a foreman of main layers, who was in charge of the work in the present case, said it was the custom to test a length of sometimes four, five, or six pipes at a time. A plug was fitted into the socket, and surrounded by wet clay, and the valve was then opened. On the morning of the accident, they were testing three joints just after seven o'clock, and had got about 100 yards from the works. A man named Grout was usually sent to turn off the gas-valve, which was just inside the works; and he had been sent to turn on the gas. Sivyer was down in the trench, close to the pipe. He had fixed the plug, and it was quite safe before the gas was turned on. Witness was in the trench, and Grout told him the gas was turned on. They tried the three joints and found them all right. After the testing was over, Grout was sent to turn off the gas; and he came back and said it was off. Witness told Sivyer to try the plug; and he stood on the top with Grout watching him take away a little clay. He found there was too much pressure, and told the deceased to put the clay back again. He sent Grout back to the works to see if he had turned the gas off properly. In the meantime, Sivyer took off another piece of clay; and witness called out to him not to do so. Sivyer took hold of the plug to open it, and witness jumped into the trench to try to stop him from getting it away. But he was a little too late, and the plug flew out of Sivyer's hands and fell into the trench about two yards away. Witness got the plug and tried to put it into the pipe again; but there was too much pressure—he could not hold it. About 12 feet away he saw a man named Bridger fall, overcome by the gas, and he was got out with a rope. Sivyer was still trying to put the plug back, and he fell down by the side of the pipe in the trench and witness fell on top of him. They were both insensible. He knew nothing more until he came to at the gas-works. Grout had been at the work about sixteen or eighteen years, and was quite used to turning the gas-valve on and off. [Plans of the valve and trench where the main was being laid were produced.] There was never any difficulty with the valve.

Dr. *Lewis*, of Bickley, said he was called to the trench at about a quarter-past seven on the morning of the accident, He found the deceased lying on some grass at the side of the road. The men were moving and rubbing his arms and legs to keep his circulation going; but on examining him witness came to the conclusion that he was already dead. His death was due to asphyxia and suffocation from coal gas poisoning.

By Mr. BLYTH: When he arrived, the men were already treating the man with oxygen obtained from the gas-works. It was quite the right treatment; and he thought the men acted with great promptness.

William Matthew Judd, works foreman, deposed that on hearing there were several men gassed, he ran to the valve, and found Grout trying to close it. He was turning it the wrong way, and was using a spanner. He asked witness if it was the right way or not. He was very excited. Witness said the valve was full open, and he told Grout to reverse it. He ran for the key, which was kept about 30 yards away; but when he got back Grout had shut the valve. Witness ran to the trench and saw the deceased and the foreman lying by the pipe. He went back to the works and sent to the spot all the help he could. He telephoned for two doctors and wired to Sydenham. In the meantime, he had sent the oxygen cylinders to the trench. Grout made no explanation as to what had happened. He was quite competent, had had a lot of experience, and should have known.

Walter James Grout was the next witness, and on being called received the usual caution. He deposed that he was told by the foreman to test some joints, and before going to turn the valve he saw that the plug was in position. After the testing he was told to "shut down again;" and he went back to the works and, as he thought, did so. He turned the valve as far as he could with the spanner, and went back to the trench. Sivyer inquired if all was right. Witness replied that he thought it was; and he asked Sivyer to try it. Sivyer pulled a small piece of clay from the drum-head; but the foreman, who was standing on the side of the trench, said to Sivyer, "You have got too much gas there; shut it up again." Sivyer replied that it was all right—it was only back-pressure; and he pulled off another piece of clay. The foreman called out, "Don't do it; I tell you not to touch it again." Sivyer took no notice, and pulled the drum-head right out. When the first piece of clay came off witness heard the gas escaping; and when the plug was out, he ran back to the works and succeeded in getting the valve shut with a spanner. Just as he did so, the foreman brought him the key.

In answer to the CORONER, witness said he could not quite explain how the gas was turned on when he thought it was off. Reminded that the works foreman had found him turning the valve the wrong way with a spanner; the valve being shown to be full open, he said he had never noticed the words on it. He had turned the valve before it was fixed in the ground, and it was all right.

Mr. *S. Y. Shoubridge*, the Company's Engineer, said the plans produced properly represented the valve used, and when fully open it would pass about 12,500 cubic feet of gas per minute. It was quite new, and worked very easily. He thought that everything was done at the time that could be done; and the Directors expressed their sympathy with the widow and relatives of the deceased.

The CORONER, in summing up, said the whole trouble seemed to have been the mistake in shutting off the valve. There was no suggestion of criminal negligence; and if the Jury were satisfied that there was none, the verdict would be one of "Death from misadventure."

A verdict was returned accordingly.

THE GASHOLDER EXPLOSION AT MOSSLEY.

Suggestions of Interference with a Sealed Pipe.

The Manchester District Coroner's inquiry last Tuesday, at the Mossley Town Hall and the Ashton Infirmary, as to the deaths of two men following an explosion at the Mossley Corporation Gas-Works (as recorded in last week's "JOURNAL," p. 633), resulted in the return of a verdict of "Accidental Death" in each case.

The chief witnesses called to speak to the accident were Mr. Jas. Taylor, the Gas Engineer and Manager, and Mr. John Bird, foreman of the men employed by Messrs. Ashmore, Benson, Pease, and Co., in the repair of the gasholder which was the scene of the explosion. The victims were Joseph Simpson and Thomas Bransby, and the accident happened on Thursday, Aug. 29. The former's body was not recovered from the gasholder tank before the Saturday, and Bransby succumbed to his injuries at Ashton Infirmary late Saturday night.

Mr. Bird, in the course of his evidence, said that in his opinion Simpson had got down on to the raft inside the holder, ready to start operations after the dinner-hour, when the explosion took place. He thought Simpson was instantly killed. Wright and Bransby, who were at the time in the air-box in the crown of the holder, he assisted to get out, while the search proceeded for Simpson, whose body was, however, not recovered until subsequently, following upon continued pumping operations. Replying to Mr. J. Taylor, Solicitor for Messrs. Ashmore, Benson, Pease, and Co., witness stated that before the job was started upon, the inlet-pipe was sealed with water by the Corporation officials. This effectively prevented gas getting into the holder. If the water in this seal had been allowed to remain, there could have been no escape of gas. He did not know whether any of the men interfered with it. If the water in the pipe had not been interfered with, the accident would not have happened. He had been working on this particular job about eight weeks. It was necessary that the men should have lighted candles to carry on operations. The job was almost finished, and all that really remained was the removal of the tools and rubbish. No one had any business to touch the water-seal until the work was completely finished. As far as he knew, his men had not let out the water, or interfered in any way with the pipe.

Mr. Jas. Taylor, the Gas Engineer, explained how the holder was emptied of gas, and preparations made for Messrs. Ashmore, Benson, Pease, and Co.'s men to start work, including the sealing of the pipes. In reply to Mr. H. E. Brothers, H.M. Inspector of Factories, he said immediately after the explosion he could not see whether the water-seal had been destroyed; but he was satisfied that it had, because that was the only possible place where the gas could have got into the holder. Answering Mr. Taylor (Solicitor), witness said he had made inquiries to see if any of the Corporation workmen had interfered, but had not got at anything tangible. He knew that on the morning of the explosion a labourer was there attending to another gas-main that required water being run through it, and that the tap to be turned was very similar to the one in question. It was 5 or 6 feet away, and turned by the same key. The labourer he had mentioned had been in the employ of the gas-works for 24 years, and was in this case doing the work of the regular man, who was away on holiday. Witness agreed that it was possible the man might have turned the wrong tap, though accustomed to the work.

The Coroner intimated that he did not propose to call the labourer named by witness; and the foreman of the Jury said he did not think it was necessary.

Before the proceedings concluded, the Chairman of the Gas Committee (Alderman Noel) said he and his colleagues wished to express, through the Coroner, their sincere sympathy with the relatives of Simpson and Bransby in their bereavement. Messrs. Ashmore, Benson, Pease, and Co. and the Coroner associated themselves with this expression of sympathy.

SALFORD GAS-WORKS EXTENSIONS.

Council Put Check on Committee's Initial Scheme.

The principal matter discussed at the Salford Town Council last Wednesday was a recommendation from the Gas Committee that the Corporation should purchase from the Earl of Ellesmere a plot of land in Liverpool Street for gas-works extensions. The site is one of 38,790 square yards; and the total cost, including the cost of the new roadway, paving charges, and boundary walls, is £53,000. There is included in the purchase a brick-making plant and buildings valued at £6147. The Borough Treasurer had reported that the annual charge—assuming the loan period one of sixty years—would be £2211, payable out of the revenue of the gas undertaking.

The question of the purchase of this land, which is contiguous to one of the existing works of the Corporation, has been before the Council since 1908, and approved several times. It was also dealt with at the Local Government Board inquiry when application was made to borrow

£250,000 for gas-works purposes. It forms part of the Provisional Order recently sanctioned by Parliament. This makes the decision of the Council at the conclusion of the discussion on Wednesday all the more inexplicable.

The subject was introduced to the members of the Council by Alderman Phillips, the Chairman of the Gas Committee. He first of all detailed the circumstances leading up to the purchase of the land, following on with some pertinent remarks as to the absolute need for steps being taken immediately to increase the storage capacity at the gas-works. They had, he said, had an independent valuation of the land made, and according to this the amount to be paid to Lord Ellesmere was fair and reasonable. At 9d. per yard, the price brought out an annual rental of £1454, which, capitalized at 30 years' purchase, represented a capital value of £43,620; while the sum to be paid Lord Ellesmere was £41,500. Alderman Phillips pointed out that the Provisional Order having passed through Parliament, the Salford Corporation were now in a position to complete the purchase with Lord Ellesmere. Their option extended to Oct. 31; and they had until Dec. 31 to find the money. One of the first things to be done at the new site, added Alderman Phillips, would be the erection of a large gasholder, because the Gas Department were really in a bad position as to storage capacity. At present, they could not store within 2 million cubic feet of a day's supply; and during a prolonged fog their position would be serious. In fact, he remembered their being on one occasion within thirty or forty minutes of the failure of the gas supply, even after the greatest efforts had been made. With a growing undertaking, they could not go on like this; and they must, therefore, without loss of time, erect a gasholder, in order to have increased storage. One great advantage about the land they proposed to purchase was that they could put upon it a gasholder, and connect it up with the existing Liverpool Street works. If another site were chosen, they would need to have a separate staff and management, erect distributing apparatus, and go a very long way towards a separate gas-works. As at present proposed, they would build a gasholder first and everything afterwards as it was required, and not before. Another advantage in the acquisition of this land was that they would have on the one side the London and North-Western Railway lines, and on the other side access to the Lancashire and Yorkshire Railway, which would mean a saving in carriage. In conclusion, he moved the adoption of a resolution to the effect that the land in question be purchased.

In answer to a question, Alderman Phillips said it would take two or three years to construct a gasholder.

Mr. A. Williamson moved, as an amendment, that the matter be referred back to the Gas Committee, with instructions to obtain and submit to the Council the opinion of a competent valuer as to the prices, terms, and conditions of the proposed purchase of land, and an estimate of the cost of the whole scheme of extension. It was Mr. Williamson's argument that the difference between £41,000 for the land and the total cost of £53,000—a matter of £12,000—was in the nature of a premium, which would not obtain if another site was chosen. In the event of another site being selected, they would not have to pay paving charges or be compelled to acquire the brick-making plant and buildings for £6147, which in his opinion would be a total waste. Mr. Williamson also remarked that, by the agreement, they were called upon to construct a new roadway and boundary walls at a cost of £3430. This new roadway would lead to the Earl of Ellesmere's coal yards; so it could be gathered to what extent the ratepayers of Salford were to benefit. But Mr. Williamson had a further objection to the Gas Committee's general scheme. Was the gas undertaking making such rapid progress, he asked, as to induce them to embark on this large expenditure? Producing some statistics, he stated that in 1908 the sales of gas showed an increase of 2·65 per cent.; in 1909, a decrease of 3·52 per cent.; in 1910, another decrease of 0·01 per cent.; while in 1911 there was an increase equal to 0 9 per cent.; and in 1912 a decrease equal to 0·12 per cent. was recorded. It was his opinion that the decrease would not end there; and he thought the Council should not launch upon any big scheme until they knew precisely what the Gas Committee and the Electricity Committee were going to do. There was, he declared, an unhealthy competition between the two departments.

In the subsequent discussion, a good deal was said about the alleged rivalry between the Gas and Electricity Committees. The latter were accused of selling current at a loss—a charge strenuously denied by the Chairman of the Committee. Alderman Hulton, in his contribution to the discussion, said the Lighting Committee had been watching experiments made in other towns as to the respective claims of high-pressure gas and electricity for street-lighting purposes. The experiments had now got to such a stage that the Lighting Committee could come to a conclusion, and would lay before the Council at no distant date a request for some of the principal streets to be lighted by high-pressure gas or electricity.

Following some further talk, Alderman Phillips was called upon to reply. Having assured the Council that there was no friction whatever between the Gas Committee and the Electricity Committee, he said that the gentlemen who had expressed the view in the course of the discussion that in a few years gas would be extinguished, were in error. Common experience all over the world showed that nowhere was electricity extinguishing gas. It was also shown that both gas and electricity had definite purposes to serve; and it was an undisputed fact that all over England gas undertakings were developing. Recent decreases recorded in gas sales were due to abnormal causes. In their own case at Salford, the increase in the consumption of gas during the last fifteen years had been at the rate of 2 to 3 per cent per annum. Before concluding, Alderman Phillips warned the Council that if they did not go on with the scheme they would have to take the responsibility altogether, and this responsibility included a fine if they fell short in the supply of gas.

On the matter being put to the vote, twenty-one were in favour of the amendment and eight against. The matter is, therefore, referred back to the Committee.

On the recommendation of the Gas Committee, the Marple Urban District Council have advanced the wages of the stokers employed at the gas-works from 4s. 10d. to 5s. per shift.

STOCKPORT CORPORATION GAS UNDERTAKING.

Mr. S. Meunier Completes Twenty-One Years of Management.

Mr. S. Meunier, the Gas Engineer of the Stockport Corporation, in his annual report, mentions the fact that he has completed the "majority" year of his management of the gas undertaking; having been appointed in 1891. He regrets that the results of the past year's working, though another record in the history of the department, did not reach the high-water mark anticipated, due to unforeseen and unavoidable causes. Thus, though the gross profit amounted to £47,315 in round figures, against £45,933 in the previous year, and the net profit to £26,657 against £26,192, the effects of the strike among the workmen in their employ, followed by the coal strike, acted detrimentally on the costs at a period of the financial year which gave very little opportunity for any recoupment. The three days' strike of their own men, with its sudden stoppage of gas production and consequent disarrangement of plant, and the time occupied after the stoppages in putting everything again into normal working order, affected the sales of gas alone by no less than 8 million cubic feet, which, taken at the average selling price of 2s. per 1000 cubic feet, amounted to £800.

Dealing with the future, Mr. Meunier reports that the prospects are not favourable, as the department is called upon to meet new expenditure. For example, the advance in wages conceded to the gas workers, and the alterations in conditions agreed to, would certainly come to not less than £3000, and might quite easily amount to £4000. Then coal would cost from £4000 to £5000 more; while for general stores an increase of £1000 could be reckoned upon. In addition, there was also the fact that notices were continually being received from various firms notifying reductions in discounts from list prices, or an additional percentage on selling prices, amounting to a difference in cost in many cases of as much as 20 per cent. The result as regarded alterations in legislation, too, was as yet not easy to estimate; while the probable additional cost of oil for the carburetted water-gas plant might be surmised when it was stated that freights alone had increased upwards of £1 per ton, and the department annually used from 2000 to 3000 tons. The lowest quotation available at the moment was 4d. per gallon to December, and 3¼d. per gallon for 1913; while Scotch firms were quoting prompt delivery at 5½d., or approximately £6 3s. 9d. per ton. Previous prices had ranged from 2¼d. to 2$\frac{15}{16}$d. per gallon. It would be seen from these particulars that the profits during the current year were bound to be very largely reduced.

The Chairman of the Gas Committee (Alderman Fernley), in moving the adoption of the report at the meeting of the Town Council last Wednesday, congratulated Mr. Meunier upon the successful working of the undertaking during his management, and said he felt sure the members of the Council would join him (the speaker) in these expressions. Twenty-one years was a long time to be in one department; and what was more, the work done by Mr. Meunier had been of a progressive character. Not a single year had passed when a profit was not shown. During Mr. Meunier's management, much expenditure had naturally taken place; but it had been profitable expenditure. The income had increased from £74,378 in 1892 to £126,000 for the last financial year. As a matter of fact, the year ended March last had been, in every sense of the word, one of the most successful in the history of the undertaking; but he was afraid it might be the high-water mark, so far as profit was concerned, for some years to come, because, as the Engineer had been careful to point out, they had in the current year to face many increases in expenditure. It was to be hoped that by larger sales of gas and the exercise of economy the department would be able to meet these additional calls. This, at any rate, was what they must work for. The report was adopted amid applause.

ILFORD GAS COMPANY.

The Ordinary Half-Yearly General Meeting of this Company was held at the Offices, Ilford, on Monday last week—Mr. WILLIAM ASHMOLE (the Chairman) presiding.

The SECRETARY (Mr. G. H. S. Iorns) having read the notice convening the meeting, the Directors' report and the statement of accounts for the six months ended the 30th of June were presented. The report set forth that the sales of gas showed an increase of 7·03 per cent. over those for the corresponding half of last year, and, in spite of the reduction in the price made from Christmas, the receipts for gas supplied had increased by £1094. On the profit and loss account, after providing for the interest charges, there was a balance of £19,885 available for distribution. The price of gas having been reduced by 1d. per 1000 cubic feet during the whole of the half year, the proprietors were, under the operation of the sliding-scale, entitled to an additional dividend of 1s. 3d. per cent. for this period; and the Directors recommended the payment of a dividend for the six months at the rate of £7 12s. 6d. per cent. per annum on the "A" and "C" stocks, and £6 2s. 6d. per cent. per annum on the "B" stock, subject to the deduction of income-tax. These payments would amount to £7009, and leave a balance of £12,876 to be carried forward.

The CHAIRMAN, in moving the adoption of the report, said it was gratifying to the Directors to be able to report a steady advance in all the departments of the undertaking, and still more, the increase in the number of consumers, and the additional number of cookers, gas-fires, and geysers issued. There appeared to be every prospect of future half years continuing to show the same successful results. During the six months, 207,178,000 cubic feet of gas were sold; the quantity sold during the corresponding period of 1911 being 193,567,000 cubic feet. They had, therefore, increased their total sale of gas by 13,611,000 cubic feet, equal to 7·03 per cent. The output of gas was more than double that recorded for the corresponding half of the year 1903, at which time the price of gas was 3s. 6d. per 1000 cubic feet, whereas now it was 2s. 9d.—showing a reduction of 9d. in nine years. Looking over the accounts generally, he thought the proprietors would agree that they represented a very satisfactory position of affairs. Economies in the manufacture of gas and in the general working of all

departments had been carefully studied. For residual products, the revenue amounted to £7135, against £6318, or an increase of £817. Tar during the half year had commanded a very good price, because of the increased demand for it, especially for road tarring; and there had been a good market for sulphate of ammonia, the price received being higher than in the corresponding half of last year. They had carbonized more than 1000 tons of coal less, and yet showed an increase in the receipts for residual products. This, besides emphasizing the rise in the market value, also denoted good working. The National Insurance Act having been passed, the Company were bound to carry out its requirements. He felt sure none of the stockholders would regret the cost, if the results turned out to the benefit of the employees. The amount the Company would have to pay was about £110 per annum. In conclusion, he had only to express the wish that the Company might continue to prosper and maintain its position in the future as it had done in the past.

Mr. J. W. F. MUMFORD seconded the motion; and it was carried unanimously.

The dividends recommended having been declared, a vote of thanks was accorded to the Directors.

The CHAIRMAN acknowledged the compliment, and proposed a vote of thanks to the officers. He said the Engineer (Mr. W. B. Farquhar), Secretary, and all the officials and workmen, had done their duty very ably indeed.

The motion having been carried unanimously,

Mr. FARQUHAR and Mr. IORNS returned thanks for the vote; the latter stating that 112 employees had become stockholders under the co-partnership scheme, and would share in the dividend declared.

A vote of thanks to the Chairman closed the proceedings.

SHREWSBURY GAS COMPANY.

Satisfactory Year's Working.

The Annual Meeting of the Shrewsbury Gas Company was held on the 2nd inst.—Mr. T. F. POOLE (the Chairman) presiding.

The report of the Directors stated that the profit on the working for the year ended June 30 amounted to £9233. An interim dividend of 2½ per cent. was paid in March last, and £500 had been set aside to meet a further deficiency in the value of the reserve fund investments caused by the great depreciation of Consols. The Directors recommended that a final dividend of 3¼ per cent. (making 5¾ per cent. for the year) should be declared, leaving a balance of £2332 in the profit and loss account. The reserve fund amounted to £11,891, and was fully invested. There had been an increase of over 4 million cubic feet in the consumption of gas during the year. The Directors had to report a considerable increase in the cost of coal for the ensuing year; but it was not their intention to make any change in the price of gas. The number of stoves on hire at June 30 was 3534; and there were 4007 prepayment meters in use. Under the supervision of Mr. William Belton, the Engineer and Secretary, 19,936 tons of coal and 139 tons of cannel were carbonized during the year; the make of gas being 213,531,000 cubic feet, of which 187,594,000 cubic feet were sold by meter and 6,843,000 cubic feet for public lighting.

The CHAIRMAN, in moving the adoption of the report and accounts, said that in the first place he must congratulate the proprietors upon the eminently satisfactory result of the year's working, in spite of the difficult times they had been passing through—and difficulties which, but for the most untiring and diligent care, might have proved disastrous to the Company. The year under review had been one of great unrest in the industrial world; and their Company, in common with most others, had suffered somewhat therefrom. The railway strike in August, 1911, caused a cessation of coal delivery for a time; and this was followed by a long period of disorganization, which was expensive to the Company by reason of frequent utilization and partial replacement of stocks. So that the coal strike of March and April, 1912, found them with less stock than they thought necessary, and they had consequently to purchase some inferior coal at enhanced prices. The Company were, however, enabled to maintain undiminished the supply, quality, and purity of their gas, and so fulfil their obligations to the public. These matters had caused the Board much consideration; and they found that, in view of the uncertainty of the labour market, it would be necessary in future to provide increased storage for the coal, which work would be undertaken shortly. Of course, increased stocks meant increased and unremunerative working capital, so much having to lie idle. Notwithstanding all this, the proprietors would be pleased to find the progress of the Company so well maintained that, while the revenue increased by £550, the expenditure only increased by £149—giving £401 additional profit. The 1d. reduction in the price of gas made on July 1, 1911, cost the Company £801, against which increased consumption had brought in £547, and they had received £968 more for residuals. It was unnecessary to mention other items; these being the outstanding features, and the general results being so gratifying. The Directors in December last invited tenders for £5156 stock and premiums, when £8499 was applied for. The stock offered was allotted at an average price of £126 10s. 7d.—a price which reflected the confidence felt by investors in the stability and prosperity of the Company. They would see that there had been set aside a further £500 to meet the deplorable depreciation of securities—making £2300 which had had to be found for this purpose. The Insurance Act was now in operation, and all the men were insured under the Health Section; but there was some confusion and uncertainty as to what men should or should not be included under the Unemployment Section. The Board were endeavouring to fulfil the demands of this intricate and involved Act, and hoped it might eventually prove of benefit to the workmen, though at considerable expense to the Company. As a result of the Minimum Wage Act and other burdens laid upon collieries, they were having to pay about £2000 more for coal during the coming year; and it was doubtful if there was much prospect of the market regaining its former level. This had prevented a further reduction in the price of gas, which the Directors had been contemplating. The Company's business continued to expand satisfactorily, as was evidenced by the fact that there was an addition for the year of 282 stoves on hire and of 137 prepayment meters; and it was pleasing to know that there was a steady increase in gas consumption still continuing. Owing to the increased attention and responsibility involved in the expansion of the business, the Directors had thought it wise to provide some additional assistance; and so they had appointed Mr. Charles M. D. Belton to be Assistant Engineer and Secretary.

The report was adopted, the dividend recommended declared, and votes of thanks passed to the Chairman and Directors, as well as to Mr. Belton and the staff.

HARROW AND STANMORE GAS COMPANY.

Increased Sale of Gas.

The Ordinary Half-Yearly Meeting of this Company was held last Tuesday, at the Holborn Restaurant—Mr. ALFRED H. BAYNES, J.P., in the chair.

The SECRETARY and ENGINEER (Mr. J. L. Chapman) read the notice convening the meeting; and the report of the Directors and the statement of accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said it would not be necessary to detain the shareholders with any lengthy remarks; but there were a few features he would like to point out. Looking first upon the receipts side, the gas-rental amounted to £21,556, which was an increase over the corresponding period of the previous year of £2593. This, he thought, was very satisfactory. The rentals from meters, stoves, and fittings had increased by £399. The prices of residuals had considerably advanced, and had added to these receipts an additional £791. There had been a few small amounts received from profits on sales and transfer fees which brought the total receipts up to £29,350, or an increase of £3805 over the first half of 1911. The expenditure had been slightly higher in every department, in consequence of the greater quantity of gas produced. One fresh item was for new services and prepayment fittings, which, under the arrangement with the Income-Tax Commissioners, were now allowed to be charged to revenue account. Though the rates appeared much greater, this was due to a re-arrangement of the accounts rather than to any large increase in the rates; the real increase being about £100 over the corresponding period. The total expenditure for the half year to June 30, including depreciation, had been £21,450, which was an increase of £2974. The profit for the six months was £7900, or £830 more than in the previous year. After payment of the dividends at the same rates as last half year, and the debenture stock interest, and adding £493 to the reserve fund, there would be £444 to place with the previous balance, making a total carry-forward of £5754. The reserve fund would now amount to £4571. The production of gas both from the coal and the oil had been thoroughly satisfactory. The consumption of fuel was low, and the unaccounted-for gas was only 3·57 per cent. The increase in the sale of gas, as compared with the corresponding period, had been 15,992,000 cubic feet, which was equal to 13·91 per cent. The capital account in relation to production, notwithstanding the large expenditure, had been further reduced by 6d. per 1000 cubic feet of gas sold. It was interesting to notice the approach the summer consumption of gas was making towards the winter consumption, owing to the great popularity of gas for cooking and heating. The Lady-day quarter's consumption was 74,632,000 cubic feet, while that for the Midsummer quarter was 56,295,000 feet. It was also satisfactory to report that the district was being better supplied with railway accommodation. The new stations of the London and North-Western Railway between Willesden and Harrow were opened in June, and a good train service was being run. There had been an increase of 400 in the number of consumers—220 prepayment and 180 ordinary—and 390 new cooking-stoves had been placed out on hire. He could not close his remarks without referring, with very great pleasure (in which he was confident all the Directors joined), to the excellent relationship existing between the Company and their staff and workmen, and to the very cordial manner in which both had carried out their respective duties, amid the turmoils of coal strikes and labour difficulties of many diversities. This had the warm appreciation of the Directors of the Company, and, he was sure, the hearty congratulations of the shareholders also. In his judgment, no better report had ever been placed before the proprietors than the one now in their hands; and these satisfactory results were due in large measure to the valuable services of their Engineer and the staff working under him. They would all sympathize with Mr. Chapman over his accident. They were all pleased to see he was getting better, and hoped he would speedily regain the perfect use of his ankle. He had to apologise for the absence of two of the Directors; the Vice-Chairman (Dr. J. W. Lee Glaisher) and Mr. A. F. Phillips being both away on the Continent.

Mr. F. J. BANCROFT seconded the motion; and it was carried unanimously, without dicussion.

On the proposition of the CHAIRMAN, seconded by Mr. SAMUEL CUTLER, dividends were declared for the half year at the rates per annum of 11 per cent. on the original "A" capital, £7 14s. per cent. on the additional "C" capital, and 7 per cent. on the additional "B" capital and guaranteed shares—all less income-tax.

Moved by the CHAIRMAN, and seconded by Mr. CUTLER, it was next agreed that a sum of £493 be carried to the reserve fund; the former remarking that they were gradually building up a good reserve.

Mr. CUTLER, in proposing that the best thanks of the shareholders be given to the Engineer and Secretary and the staff for the efficient services rendered by them during the half year, said the Chairman had already alluded to the zeal and energy with which Mr. Chapman carried on the work of the Company. Speaking from observation, he (Mr. Cutler) could testify to the great zeal, enterprise, and care of the Company's interests shown by Mr. Chapman. When they remembered the coal strike, the difficulty in obtaining materials, and all those troubles that engineers knew so well, and the difficulty of keeping pace with the rapid development of the business, they would realize that they had the right man in the right place. They had a good staff, also; and it

spoke volumes for Mr. Chapman that he had been able to gather around him such a body of men.

Mr. F. R. SMITH, in seconding, remarked that the Company at the present time was progressing all along the line. The capital expenditure was coming down, the reserve fund was going up, co-partnership was being started, and every department of the business exhibited growth. Moreover, he was glad to see on this occasion that the whole of the prepayment fittings were being written off revenue account. All these things reflected the greatest credit on Mr. Chapman, who had given further proof of his devotion by being present at the meeting, in spite of the fact that he was suffering from the effects of a painful accident.

The CHAIRMAN supported the proposal, as did also Mr. BANCROFT, who congratulated Mr. Chapman on the excellent results of the half year. He said he had looked very carefully through the accounts, and they were highly satisfactory—whether they were regarded from the point of view of the price of gas in the holder, the cost of carbonizing, or the returns from residuals. Their Engineer had had a very busy half year, with the capital expenditure of £10,000.

The vote having been heartily accorded,

Mr. CHAPMAN, in acknowledgment, said a spirit of enthusiasm animated the whole of the staff. They had more or less been brought up together. Practically the whole of the men, except the very old ones, had joined the Company as boys or young men, and had grown up in the service. It was very pleasing to see so much zeal and care in the carrying on of the work. Of course, they had at the same time to thank fortune for bringing them so many railway stations, and so much property, which was continually increasing, notwithstanding the high price of materials. The business was now progressing more rapidly than at the corresponding period of last year.

Mr. J. CASH proposed a hearty vote of thanks to the Chairman and Directors; remarking that the present accounts were certainly the best he had seen. The past half year must have caused a considerable amount of anxiety to the Board; and the shareholders should be thankful for the way in which everything had been managed. So far as he was aware, no reduction of pressure or alteration of any kind had taken place. The Company seemed to him to be one of the soundest that he knew. They had a good district and a good network of railways, which meant an increase in the output of gas year by year. This spelt prosperity; and with a progressive Board, such as they had, there need not be the slightest fear for the future of the Company.

The proposition was seconded by Mr. W. RICHARDS, and unanimously carried; and the CHAIRMAN'S reply concluded the proceedings.

HASTINGS AND ST. LEONARDS GAS COMPANY.

Presiding at the meeting of the Hastings and St. Leonards Gas Company last Thursday, Dr. G. G. Gray, J.P., referring to the report and accounts dealing with the six months to June 30, said they had good reason to congratulate themselves, and especially the Engineer (Mr. C. E. Botley), on having successfully weathered the difficulties and dangers of the past half year, and got safely home—by which he meant having made a sufficient profit to pay the usual statutory dividends in full, and, indeed, having made more, for they were able to write another £1000 off their old works and plant account, to write off the loss on additional lamps converted, to write-down their Consols, and still carry a balance forward. The half year had been the most anxious he had ever had during the quarter-of-a-century he had been a Director. The Board could probably appreciate better than most of them the intense anxiety and sustained strain which Mr. Botley had for weeks and weeks to undergo. At the last meeting, he told them they had a sufficient stock of coal to carry them through the strike, which seemed imminent, and fortunately this belief was realized. Few people anticipated that the coal strike would have lasted so long; and it was not only the strike, but the after-effects. Naturally, those on the spot had the better chance of getting served first; but all gas companies were practically in the same condition, and there was no chance of borrowing. To the strike must be added the uncertainty which long prevailed. Yet it was necessary, with the possibility of the prolongation of the strike, if they did not wish to run the risk of diminished supply, to obtain coal. Foreign coal was very difficult to be got, and was only obtained at an exorbitant price. But they were bound to buy coal, rather than run the risk of interfering with their supply. Mr. Botley estimated that the strike would cost them about £1500; and he did not think Mr. Botley was far out. On the works they had practised care and economy in every way. They had refused new custom, rather than share with new consumers that which belonged to old and present consumers. But, "All's well that ends well;" and, while some towns were in darkness, they maintained their supply, public and private, unimpaired, and practically without a single complaint. In future they would maintain a larger stock of coal. The Board thoroughly appreciated the way in which the Company had been steered in these difficult times by Mr. Botley; and with the balance-sheet in their hands they knew all the more how this appreciation was merited. They had got through a difficult time better than some of their neighbours and competitors, without interfering with the supply of public and private lighting.

The report (which showed a profit balance of £13,229) was adopted; and a vote of thanks was accorded to the Chairman, Directors, officials, and staff. In responding, Mr. Botley said that at the time of the coal strike he received the heartiest support from the staff and the workmen. They had then to buy coal from Germany; and when the coal mines were re-opened, the temptation was felt to supply foreign countries first and keep English people waiting.

Woking Water and Gas Company.—At the meeting of this Company last Tuesday, the accounts presented for the six months ended June 30 showed a balance of £6366 at the credit of the profit and loss account, compared with £5322 this time last year; and the Directors recommended the payment of a dividend at the rate of 5½ per cent. per annum, less income-tax. This would absorb £4357, and leave £2009 to be carried forward.

DOVER GAS COMPANY.

In the course of the report which was adopted at the recent half-yearly general meeting of the Dover Gas Company, the Directors stated that prior to the commencement of the coal strike they had drawn from the collieries as much as they could obtain of their contract supply; but in order to guard against the risk of running short of coal, they had had to secure a small quantity at enhanced prices. The consumers, at the request of the Board, economized in their consumption during the continuance of the strike; and the Corporation authorized a reduction in the hours of lighting and the number of street lamps lighted. These facts explained, to a great extent, the reduction in the quantity of gas sold compared with the corresponding half of last year. Another result of the strike was that it had been necessary to renew the coal contracts at higher prices. In view of the difficulties encountered, the Directors thought that the result of the half-year's working was satisfactory. They had carried £500 of the realized profit to the amount written off capital account for the Russell Street holder, and recommended that a dividend be paid for the six months on the Company's stock and shares at the rate of 7½ per cent. per annum.

The Chairman (Mr. W. Mannering) pointed out that, owing to the circumstances detailed in the report, there was a decrease of 5 per cent. in the quantity of gas sold, as compared with the corresponding half year. The revenue showed a decrease from sales of gas of £759; meter and stove rentals increased £41; and residuals decreased £29, though all the products had realized higher prices. Thus there was a decreased revenue of £747. Coal cost £184 more (though 548 tons less were used), and altogether there was an increased expenditure of £351. This made the balance carried to profit and loss account £4354, against £5452—a decrease of £1098. After charging interest, and transferring the £500 mentioned in the report, there was a net profit of £3562, which was sufficient for the usual dividend and leave £30 to be carried forward. He expressed the appreciation of the Board of the efficient way the staff continued to discharge their respective duties.

A vote of thanks to the Board and the staff was responded to by the Chairman, the Secretary (Mr. E. C. Fielding) and the Resident Engineer (Mr. E. C. Herring).

ENFIELD GAS COMPANY.

Sir Alfred Somerset, K.C.B., recently presided over a well-attended general meeting of the Enfield Gas Company; and in moving the adoption of the accounts for the half year ended the 30th of June, which showed £4209 as the net profit for this period, he referred to the satisfactory growth of the business of the Company, and to the sound condition of the undertaking. Speaking of the recent coal strike, he remarked that like every other coal-using concern, the Company had considerable difficulty in getting proper deliveries of coal for some time before the strike cut them off completely. But as they had for some years kept a stock in hand of liberal proportions, the Directors were able to provide a supply of gas normal in every particular throughout the whole time of the disturbance, and the consumers were entirely free from inconvenience of any sort, so far as their gas supply was concerned, from the beginning to the end of that very serious disruption of affairs in the coal trade, which entirely stopped so many industries for a time, and did harm which could never be remedied all over the country. As the proprietors were aware, the Company had not installed a water-gas plant, but were entirely dependent upon coal for making gas. The strike was therefore a much more serious matter to them than to the great majority of gas companies. It was this fact, and to the ever-increasing sense of the instability of the labour market, which, in the Directors' view, demanded the keeping-up of large coal stocks, and justified the cost which such a policy entailed. He had referred to the labour market as being in an unstable condition; but he would put as outside the disturbed area those businesses in which co-partnership had been introduced. He was informed that the spirit shown by those who were employed in such concerns was a very different one from that which patently prevailed among the generality of the men employed elsewhere. This was indeed very hopeful and encouraging news, especially to the proprietors of companies where, as in the case of the Enfield Company, the system had been introduced. Mr. Alfred Ford, in seconding the motion, informed the meeting that the total number of consumers had now reached 10,523—an increase of 428 during the year; that the cookers in use numbered 7432, or 460 more than at the corresponding time last year; and that the increase in the quantity of gas sold was 7,255,000 cubic feet, or equal to 6·28 per cent. The motion was unanimously adopted. The recommended dividends at the rate of 5½ per cent. per annum on the consolidated ordinary stock, and 5 per cent. per annum on the consolidated preference stock, were passed; and the meeting sanctioned the payment of a retiring allowance to the present Works Manager, Mr. A. W. Archer. The services of the Chairman and Directors and of the General Manager and Secretary (Mr. C. W. Offord) and staff were the subjects of appreciatory votes, which were suitably acknowledged by Colonel Somerset and Mr. Offord.

Pernambuco Water Company, Limited.—A meeting of bondholders of this Company was held last Tuesday, under the presidency of Mr. R. C. H. Harrison, to consider a resolution approving an arrangement under which the Government of the State of Pernambuco had agreed to acquire the Company's undertaking, and to become responsible for the payment of interest on, and the amortization of, all the outstanding bonds. The Chairman explained that early in the present year the Company had entered into an arrangement with the Provincial Government under which the latter agreed to take over the property, reserving the rights possessed by the first and second mortgage bondholders as they originally existed. The arrangement come to was an excellent one, for in one respect a State Government was much stronger than a Water Company. He moved the resolution, and it was carried.

HOLBORN PUBLIC LIGHTING.

Cost Last Year—New Combined Installation.

In the annual report of the Holborn Borough Council which has just been issued, it is stated that the borough was lighted during the past year mainly on the incandescent gas system; the Gaslight and Coke Company providing the supply at 2s. 2d. per 1000 cubic feet. For lamps fitted with meters, the Council paid a meter-rent of from 3s. to 12s. per annum. During fog and on dark days, the public lamps were lighted; the consumption of gas being computed on the hours the burners were alight. The lamps were lighted, extinguished, cleaned, and maintained by the Gas Company, who received from the Council the following amounts per annum: Lanterns fitted with single incandescent burners, £1 5s.; do. with double do., £1 16s. 6d.; do. with treble do., £2 15s.; do. with flat-flame burners, 18s. For the high-pressure lamps in Kingsway, the Council paid the Company the sum of £3 7s. 6d. per annum, which included lighting, extinguishing, and cleaning the lamps; repairs being paid for in addition, The cost of public lighting, including the supply of gas and cleaning, lighting, and extinguishing the lanterns, was £6974 17s. 5d.

Certain experiments were carried out in various streets in the borough with inverted mantles, and were fully reported upon to the Council by the Surveyor on July 5, 1910. Subsequently Gower Street was selected for experiments in lighting by electricity and gas—half the length of the street being handed over to the several Electric Lighting Companies having statutory powers in the borough, and the remainder of the street being left to the Gas Company. For the purposes of the experiment, new columns were erected by the Companies, and lanterns supplied complete with fittings to ensure a minimum of 300-candle power at agreed angles when measured by the Council's photometer. The experiments were exceedingly useful in assisting the Council to arrive at a decision in the matter; and eventually they accepted a tender of £7645 submitted in the names of the Gaslight and Coke Company, as representing the gas industry, and the Metropolitan Electric Supply Company, Limited, the County of London Electric Supply Company, Limited, and the Charing Cross, West End, and City Electricity Supply Company, Limited, on behalf of the Electric Light Companies, for the installation and maintenance for ten years of the two systems of lighting for the borough—viz., high and low pressure gas and electric light—in accordance with terms and conditions embodied in a specification prepared by the Surveyor. For the annual sum named, the contractors will carry out the whole of the work necessary to instal the new systems, and will supply illuminant to, and light, extinguish, clean, and maintain, the whole of the public lamps in the borough, and give an illuminating power of 424,140 candles. For the year 1909-10, the cost of public lighting was £7102, and the illuminating power was 140,000 candles.

PLYMOUTH GAS COMPANY AND THEIR EMPLOYEES.

An Athletic Association—Entertainment to Officials and Workmen.

During the past summer, an Athletic Association has been formed in connection with the Plymouth and Stonehouse Gas-Works; and the members recently held their first annual sports. Excellent arrangements were made by a Committee of which Mr. P. S. Hoyte, the Engineer and Manager of the works, was the Chairman, Mr. G. H. Bolton, the Treasurer, and Mr. J. Driscoll, the Secretary; and the various events on the programme interested a numerous company of the employees and their friends. The weather was beautifully fine; and the whole proceedings were most successful and enjoyable.

In the evening, the Directors entertained at supper the officials and workmen and their wives—upwards of 700 being present. Sir Joseph Bellamy, the Chairman, presided; and he was accompanied by several of the Directors. During supper, the band of the Royal Garrison Artillery, which had played on the sports ground, gave a selection of music; and afterwards there was a concert—the programme arranged by Mr. T. Gibbons, the Company's Chief Collector.

Mr. J. Walters, the foreman of the works, proposed a vote of thanks to the Chairman and Directors, whose interest in the workmen was, he said, shown in many ways. The past year had brought anxieties; but the Directors had conducted the affairs of the Company in an extremely able manner through a critical time, and the position of the Company had been maintained.

Mr. French, who seconded the motion, referred to the co-partnership scheme, which he said was one of the finest things the Directors had done for the working men of the Company.

Sir Joseph Bellamy, who was received with musical honours, distributed the prizes to the successful competitors at the sports, and then acknowledged the hearty recognition of the assembly of what had been done by the Board for the benefit of the workers. They were glad, he said, to know that it had met with approval. The co-partnership scheme, as they knew, necessitated a very considerable amount being taken from the gross profits of the undertaking; but the Directors were perfectly satisfied that the money would not be lost, and that the good-will engendered between the workmen and the Directors would bring back many times over the intrinsic value of the scheme. The Directors attached considerable importance to the thrift fund, and had decided to increase to 5 per cent. per annum the interest allowed to those who put their savings into the fund. The Company did not want money, for they had a large balance in the bank; but the Board recognized that if the thrift scheme was to be the success they hoped, they must encourage it in every way possible. In consequence of the outlay brought about by the co-partnership scheme, they had not been able to continue the outings which had been held in former years; but they thought a supper and entertainment such as they were enjoying would give the opportunity for spending a few hours together. He congratulated them on the success of the sports, and on the excellent manner in which they had been carried out.

Mr. Hoyte said the officials were delighted at the interest taken by the Directors in the sports, and he was pleased to say that Sir Joseph Bellamy had consented to become President of the Athletic Association.

LIVERPOOL CORPORATION WATER SUPPLY.

Annual Report of the Engineer.

We have received from the Liverpool Corporation Water Engineer (Mr. Joseph Parry, M.Inst.C.E.) his report for the year 1911.

The opening pages are devoted to some observations on the rainfall, the total of which, though the summer was so dry, was only slightly below the average. July was an unusually dry month, and many towns and villages suffered severely from want of water. In Liverpool, and in all the places dependent upon it for water, the supply was abundant; and Liverpool was able to assist less fortunate places. The Rivington reservoirs at no time held less than four-tenths of their full contents. Lake Vyrnwy, with a maximum depth of 84 feet, was at no time lower than 11 feet below the overflow. The heaviest total fall in any one month on the Rivington watershed was 8·42 inches in December; and the highest rainfall registered at Vyrnwy in any month was 12·97 inches in November.

Dealing with the consumption of water, the report sets forth that the average quantity supplied per day during the year was 35,294,000 gallons, and the estimated population was 1,098,864. The corresponding figures for 1910 were 33,164,000 gallons and 1,091,598—an increased daily consumption of 2,130,000 gallons per day. A table is given which shows that the quantity of water supplied during the year for all purposes within and around the city (compulsory area) was 11,263,770,000 gallons, and that supplied outside the area comprised 253,198,000 gallons in the town of Chorley, and 1,330,069,000 gallons supplied in bulk to various towns and districts, including Runcorn and Wallasey—making a total of 12,847,037,000 gallons. It was derived from the following sources: Vyrnwy, 7,078,404,000 gallons; Rivington, 4,627,023,000 gallons; Wells, 1,141,610 gallons. The water was examined 463 times during the year; and Professor Glynn reports that its very great bacterial purity was well maintained throughout.

In October, the contract for the construction of the new Malpas balancing reservoir was let to Messrs. Jowett Bros. It will be circular in shape; having an internal diameter of 240 feet and a centre depth of 15 ft. 6 in. of water. It will hold more than 4½ million gallons. The walls and floor will be of concrete, supported at the back by an embankment formed from the excavated materials. It will be at a level of 440 feet above Ordnance datum.

The increased attention paid to afforestation is shown by the fact that the additional area planted last year was 96 acres; making the total area of new plantations on the Rivington gathering-ground 658 acres. The total number of trees planted out was 371,502; and about 800,000 were lined out in the nurseries. At Vyrnwy, the total acreage of new areas planted was 106, and the number of trees planted was 330,825. The nursery work included the lining out of no less than 658,500 seedlings.

The financial portion of the report shows that the capital expended on the works up to Dec. 31 last was £6,498,780. The revenue for the year was £374,653, and the expenditure £370,838.

DERWENT VALLEY WATER-WORKS.

Inauguration of the Undertaking.

Representatives of the municipalities concerned in the creation of the new Derwent Valley Water-Works, together with many specially invited guests, assembled on Thursday at the inauguration of the first portion of the undertaking, which has been designed to meet the wants of Leicester, Derby, Sheffield, and Nottingham. In a spot of rare picturesqueness in the Peak County, where the great Howden dam, with its massive masonry, has been constructed, the ceremony was performed by Sir Edward Fraser, D.C.L., of Nottingham (the Chairman of the Board), of turning on the water, which finds its way by gravitation to the large centres of population. With episcopal benediction, the scheme was launched upon which over £3,250,000 has already been expended; and at the inevitable speech-making which attended the formal ceremony and the subsequent luncheon proceedings, there were many encomiums bestowed upon those who have been responsible for the administrative and engineering details of the undertaking, the completion of which may entail the expenditure of another £3,000,000.

While there is no question of the necessity of the source of the new supply as far as Leicester, Sheffield, and Derby are concerned, there is little doubt (though it has not been officially confessed) that, as far as Nottingham's immediate interests are affected, the scheme is likely to entail an expense entirely disproportionate to the city's requirements. At a time when the matter was being considered by the Parliamentary Committee, there was obvious justification for Nottingham's claim to a participation in a share of the water to be impounded in the Derwent Valley; but newer sources of supply have since been discovered and utilized nearer to the city's boundaries, with the result that, in its present unprogressive commercial state, and with a heavy incubus of municipal debt, Nottingham could be well content to be free from the financial liability which the scheme will entail.

There was a very great amount of fitting congratulation on Thursday, especially as to the innumerable engineering difficulties which had been successfully surmounted through the skill of Mr. Sandeman, who, in response to a toast proposed at the luncheon by Sir William Vincent, the Deputy-Chairman of the Board, alluded to the fact that the actual expenditure up to date had been kept within £60,000 of the estimate. Still, it was not with light-hearted complacency that the total could be contemplated by some of the visitors.

It had been hoped that their Majesties the King and Queen might, coincidently with a projected visit to Chatsworth, have attended the opening ceremony; but Royal engagements elsewhere precluded the possibility of the acceptance of the Board's invitation. In performing the task, Sir Edward Fraser (who was the recipient of a model in silver of the dam at the base of which the guests gathered) said they were witnesses of the consummation of a great work. Many years ago, driven by the necessity to secure for their towns an abundant supply of water, by a common impulse the minds of the great Corporations

interested in the scheme were directed to the fair countryside which, in their judgment, was one of the fairest portions of the realms of England. After a period of strife and contention between the different authorities, both in regard to the source of the supply and the cost involved, the Derwent Valley Water Board (in the chairmanship of which Sir Edward succeeded the late Alderman Gainsford) was brought into existence; and for twelve years they had performed the task which Parliament had allotted to them. During this period the work had progressed, until they now witnessed in that great structure, in all its massive solidity, an enduring monument for ages to come of the public spirit and engineering ability which distinguished the opening years of the Twentieth Century. Might the great fountain of water which had been stored from the streams now go forth to gladden the lives of men, and promote their health—not only the men of the present day, but of unnumbered generations yet to come.

At the subsequent luncheon, served in a huge marquee, in which the thousand guests were glad to take comfortable refuge after a pitiless rain which earlier in the day had swept the Derbyshire tors, Sir Edward responded to the principal toast, proposed by Sir Thomas Roe, and congratulated Mr. Sandeman, the Engineer, and Mr. O. B. Steward, Clerk to the Board, upon the ability which had characterized their work. Mr. Samuel Roberts, M.P., proposed the toast of the four Corporations concerned, emphasizing the great value of the scheme as a significant illustration of the value of joint municipal enterprise. The Lord Mayor of Sheffield replied; being followed by the Mayors of Derby, Nottingham, and Leicester.

The speech-making, as at most English functions in these days, was a trifle too long drawn-out, and nobody was sorry to get away from the marquee to revel again for awhile in the beauties of the Derbyshire hills, which have a more commanding fascination than the best-devised post-prandial efforts.

WATER SUPPLY SCHEME FOR FLANDERS.

The Engineering Supplement of "The Times" recently contained the following particulars respecting various schemes of water supply in Flanders:—

In connection with a scheme for utilizing water from the Houyoux River (near Modave), a tributary of the Meuse in the Liége province, between Liége and Huy, for supplying a number of localities in Flanders, the Compagnie Intercommunale des Eaux have decided to expend a sum of nearly 2,600,000 frs. in constructing two sections (out of five) of a conduit for conveying the water from the Houyoux to Mazy, in the Namur Province, where it will join the present aqueduct supplying Brussels with water from the Bocq. The first section, extending over about 5¼ miles, will consist of an aqueduct of rectangular section, almost entirely in tunnel, and built in concrete. It will start from Modave, where collecting works have been in progress for more than three years, and will lead to the Meuse along the Houyoux. The other section, for which tenders have been invited, consists of 5¼ miles of aqueducts in concrete of rectangular section, of which about 4 miles will be in tunnel. These works are to be completed within three years and six months.

The scheme for the water supply of Flanders will necessitate a large reservoir, capable of holding 5¼ million gallons—which it is proposed to build in ferro-concrete. From the reservoir a conduit, 78 miles long, constituting the main trunk of the new water supply, will lead to Ghent and Ostend. The works for this part of the scheme will be undertaken at such a time that they will be completed when the collecting works in progress at Modave have been finished. It is stated that the engineering preliminaries are almost complete, and that most of the negotiations for the acquisition of land have been carried through.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The Fifty-First Annual Meeting of the North British Association of Gas Managers was held on Thursday in the Marischal College Buildings, Aberdeen. Mr. Samuel Milne, the Gas Engineer and Manager to the Aberdeen Corporation, presided over a large attendance. Lord Provost Maitland, who was accompanied by members of the Gas Committee, extended a cordial welcome to the Association. On the motion of the President, seconded by Mr. J. W. Napier, of Alloa, the Association resolved to erect a memorial tablet upon the house at Bello Mill, Lugar, Ayrshire, where William Murdoch, the inventor of gas lighting, was born. A full report of the proceedings at the meeting will be found in another part of the "JOURNAL."

Aberdeen.—Mr. Sangster, the Convener of the Aberdeen Corporation Gas Committee, in moving the adoption of the gas accounts at the Town Council meeting on Monday, said that the expenditure to July 31 last was over £457,000, while the debt, represented by market value of the annuities still outstanding, was £108,000, and the mortgages £31,000—in all, £139,000, as against an expenditure of £457,000, a difference of £318,000, which has been repaid since 1871, the date on which the undertaking was acquired by the Council. The income had been, in round figures: For gas, £92,046; for coke and tar, £31,296, amounting, with some minor items, to £125,489—about the same revenue as last year, notwithstanding the reduction made in the price of gas of 3d. per 1000 cubic feet. The expenditure has also been about the same as last year. After paying annuities, interest, sinking funds, &c., the free balance is £4677. This balance, added to that brought from the previous year, makes £12,452 in hand. There were 45 million feet of gas accounted for in excess of 1910-11, or 5·8 per cent. Last year the increase was 3 per cent., which was then considered good. This great increase is no doubt attributable to the enormous impetus given by the gas exhibition, and by lending gas cookers, grills, &c., free of rent. The number of cookers has increased from 3548 last year to 9408 this year; and heating appliances, although rent is still charged, have also increased from 1492 to 3121. Taken both together, the number of stoves has increased from 5000 to 12,500. The estimates have been prepared; and it has been found necessary to set down no less a sum than £63,000 for coal, caused by increased prices and the larger quantity required. The Committee recommend that consumers through prepayment meters, who had no reduction last year, should now receive a reduction equal to 4 feet extra per penny; making 33 in place of 29 cubic feet as formerly. This quantity works out at 2s. 6½d. per 1000 cubic feet—a reduction of 4½d., so that the prepayment rate is only 3½d. per 1000 cubic feet above that paid by ordinary consumers. Consumers, ordinary and prepayment, number 42,539. The quantity of gas made for the year was nearly 845 million cubic feet, which constitutes a record. The accounts were adopted.

Airdrie.—The Town Council have decided to raise the price of gas from 2s. 6d. to 2s. 9d. per 1000 cubic feet to ordinary consumers; the price to consumers by prepayment meter being 3s. 2d. per 1000 cubic feet. The cause of the increase is attributed mainly to the higher price of coal, both at the time of the strike and on the new contracts.

Carnoustie.—At a meeting of the Carnoustie Town Council on Monday night, Councillor Alex. Duncan, in moving the approval of the minute of the Gas Committee, stated that the valuation of the gasworks at £1239 had been accepted by the Assessor. On the first year's working there was a credit balance of £570; for the year 1911-12, the balance was £691; and but for the rise in the price of coal at the time of the strike they would have been another £100 to the good. As the accounts stood, there was a balance of £1261 on the two years' working. The price of gas to slot-meter consumers would be reduced by 2½d. per 1000 cubic feet; the price being 3s. 11½d.

Innellan.—The public gas lighting scheme for the Innellan district was brought to a successful completion on Saturday evening, when a largely attended meeting of the ratepayers took place round a specially decorated lamp at the pier-head, where Mrs. James Isdale, of Dunfeurach, turned on the light. County Councillor Duncan Lamont presided, and Professor Murison moved a vote of thanks to Mrs. Isdale. Immediately after the ceremony, a reception by the Lighting Committee was held in the Royal Hotel, at which a representative gathering of ratepayers and friends attended. Councillor Lamont presided; and Dr. Macintyre, on behalf of the Contractors and friends, presented Mrs. Isdale with a silver rose-bowl as a souvenir of the occasion.

Kirkcaldy.—The report by Mr. Kincaid, the Gas Manager, as to the proposed extension of the works was considered at a meeting of the Gas Committee of the Kirkcaldy Town Council on Thursday evening. The complete scheme is estimated to cost about £46,800; but it is prepared with the purpose of forming a basis for any new works which might be necessary, so that whatever expenditure may be involved will be utilized in such a manner as to form part of the scheme. The Committee fully discussed the proposals; but it was decided to delay taking any steps meantime—the question being left for future consideration. Mr. W. L. Macindoe, who was Liquidator of the Kirkcaldy Gaslight Company, has sent a circular to the shareholders replying to the report of the Committee appointed to examine the law accounts in regard to the arbitration proceedings. The great bulk of the report, he says, consists of animadversions of his management of the Company. The best answer to these charges was to point out to the shareholders the prosperity the Company had enjoyed during his period of secretaryship, and the benefits shareholders had received during that time. In the year 1897, there were issued to the shareholders 2450 shares at £5 each. These shares were ultimately worth £10. This issue of capital was therefore equivalent to a cash payment of £12,250. In 1908, there was issued to the shareholders, as bonus shares without any payment, £16,330 of capital, or 3266 shares of £5 each. These shares were also ultimately worth £10. This issue of bonus shares was therefore equivalent to cash payments of £32,660.

Motherwell.—At a meeting of the Motherwell Town Council, a notice of motion was put forward to compulsorily acquire the undertaking of the Motherwell Gas Company, Limited. For many years a dividend of 10 per cent. has been declared by the Company.

Peterhead.—At the monthly meeting of the Peterhead Town Council—Provost Leask presiding—Mr. William Martin, the Convener of the Gas Committee, moved the adoption of the gas accounts for the year. He drew attention to the increased profit made, amounting, in round figures, to £2985, as against £2508 in the previous year—an improvement of £476. This was brought about by the increased sale of gas, amounting to £149 3s. 2d.; increased sale of residuals, £470 2s. 11d.; increased rents of property, £43 18s. 2d., &c. The expenditure was as follows: Manufacture of gas, £7015 4s. 4d.; distribution, £504 18s. 3d.; rents, rates, &c., £382 19s. 8d.; sinking fund and interest, £2182 6s. 2d.; incidentals, £225 11s. 4d.; general administration, £16 4s.; bad debts, £26 1s.—a total of £10,353 4s. 9d. The income was: From gas sold, £8349 18s. 6d.; residuals, £2591 11s. 8d.; burners and mantles, £15 6s. 4d.; rents of property, £213 0s. 9d.—a total of £11,169 17s. 3d.; so that the balance was a net profit for the year of £816 12s. 6d., which, added to the balance from 1911, left a surplus for the year of £1160 17s. 6d. The Committee felt it their duty to give effect to the recommendations made year after year by the Secretary for Scotland to add to the depreciation and renewal fund, and set aside £523 3s. 7d. They also agreed to start a suspense account on bad debts, setting aside £37 13s. 11d.; leaving a balance to carry forward of £600. The liabilities totalled £31,136 5s. 10d., and added to this was the now substantial depreciation and renewal account of £1250, and the suspense account for bad debts, £37 13s. 11d.—a total of £32,423 19s. 9d. The assets totalled £33,023 19s. 9d. The surplus assets thus amounted to £600; being the balance of the £1160 17s. 6d. depreciation, &c. The Committee decided to recommend that ordinary consumers receive gas at the same rate as before, and that the slot-meter rate be reduced 4d. per 1000 cubic feet; leaving the price 2d. above that charged to ordinary consumers. Mr. James Gordon moved disapproval of the abstract accounts; but after discussion the motion was carried by 7, as against 3 voting for the amendment.

Stonehaven.—The Managers of the Stonehaven Gas Company are taking steps with a view to the registration of the Company under the Companies Act. At present the £1 shares of the Company, of which there are 2500, are selling at £4 each; and it is proposed to convert these into 10,000 £1 shares.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 7.

Sulphate of Ammonia.

The market for this material has continued firm throughout the week, with prices still tending in the favour of sellers. There has not been a very large volume of new business from consumers abroad, but the requirements of middlemen have proved ample to absorb current production. The nearest values at the close are £14 12s. 6d. per ton f.o.b. Hull, £14 13s. 9d. per ton f.o.b. Liverpool, and £14 15s. per ton f.o.b. Leith. Manufacturers remain very strong in their views regarding the forward position, and it is reported that contracts have been made at £14 15s. per ton for September-December delivery, and at £14 17s. 6d. per ton for January-June, f.o.b. at the best ports, in equal monthly quantities.

Nitrate of Soda.

This article continues to be firmly held in all positions, and the quotations on spot are repeated at 11s. 4½d. per cwt. for 95 per cent. and 11s. 6d. for 96 per cent. quality.

LONDON, *Sept.* 9.

Tar Products.

The markets for tar products remain firm. In pitch, business has been rather difficult during the past week; but it is reported that several parcels have been sold at slightly lower values. Benzols are firm, and maintain their price. There is a very good demand for both solvent and heavy naphtha for prompt and forward delivery. Crude carbolic remains the same. High prices are quoted for prompt delivery; but business for forward is practically impossible. Creosote is exceedingly firm; and there are many inquiries in the market for both prompt and forward delivery.

The average values during the week were: Tar, 29s. 6d. to 33s. 6d. *ex* works. Pitch, London, 50s. to 51s.; east coast, 50s. to 51s., west coast, Clyde 51s. 6d. to 53s. 6d., Manchester 49s. 6d. to 50s. 6d.; Liverpool 50s. 6d. to 51s. 6d. Benzol, 90 per cent., naked, London, 1s. 1d. to 1s. 2d.; North, 1s. to 1s. 1d.; 50-90 per cent., naked, London and North, 10½d. to 11¼d. Toluol, naked, London, 11½d. to 1s.; North, 11d. to 11½d. Crude naphtha, in bulk, London, 5½d. to 6d.; North, 5d. to 5½d. Solvent naphtha, naked, London, 1s. 1¼d. to 1s. 2d. f.o.b.; North, 1s. 1d. to 1s. 1½d. f.o.b. Heavy naphtha, naked, London, 11¼d. to 1s. 0¼d. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3d. to 3¼d.; North, 2⅞d. to 2⅞d. salty, 3⅛d. to 3¼d. liquid. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east coast, 2s. 6½d. to 2s. 7½d.; west coast, 2s. 5½d. to 2s. 6½d. Naphthalene, £4 10s. to £9 10s.; salts, 45s. to 50s., bags included. Anthracene, "A" quality, 1½d. to 2d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has not been very much business doing in this article during the past week, though prices have remained firm. The inquiry has been good; but owing to the high figures being asked by makers, business has been difficult. Actual Beckton to-day is quoted at £14 2s. 6d. Outside London makes are £13 17s. 6d. to £13 18s. 9d.; Hull, £14 10s.; Liverpool, £14 12s. 6d.; Leith, £14 13s. 9d. to £14 15s.; Middlesbrough, £14 10s. For the forward position, a slight premium is asked.

COAL TRADE REPORTS.

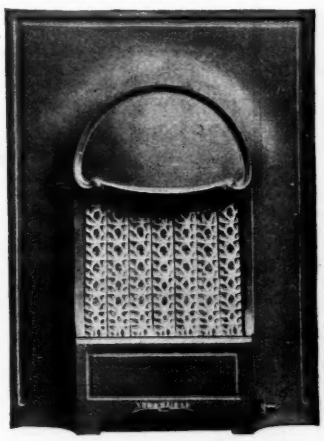
Northern Coal Trade.

With rather more steamers arriving in the ports, shipments of coals are fuller and the trade is firmer. Best Northumbrian steam coals are steady at 14s. per ton f.o.b.; second-class steams are 12s. 3d. to 12s. 6d.; and steam smalls are from 8s. 6d. to 9s. 6d. Work at the collieries is fairly steady; and the output is well taken up. In the gas coal trade, the demand is increasing. Best Durham gas coals are from 12s. 10½d. to 13s. per ton f.o.b.; and second-class kinds are from 12s. to 12s. 3d. "Wear specials" are steady, and are from 13s. 6d. to 13s. 9d. per ton f.o.b. Among the contracts that are reported as decided is that for the gas supply of Stavanger—some 9000 tons of Durham best coals, at a price that is expected to leave about 13s. 6d. per ton f.o.b. in the Tyne. A sale has also taken place of a considerable quantity of second-class gas coals for delivery over next year to Italy at about 11s. 9d. per ton f.o.b., and some other lots are in treaty, though the high rate of sea carriage is one determent. In coke, the tone of the market is very strong. Gas coke sells more freely. The production is increasing, but the price is firm for good gas coke at 20s. to 20s. 6d. per ton f.o.b.

Scotch Coal Trade.

There has been a very satisfactory tone throughout the coal trade during the week; and a feature of the market has been the extraordinary demand for all kind of nuts. On Friday the f.o.b. prices on the Glasgow Coal Exchange were: Steam coal, 11s. 6d. to 12s.; splint, 13s. 6d. to 14s.; ell, 12s. to 12s. 6d.; trebles, 13s. 6d. to 14s.; doubles, 13s. to 13s. 6d.; and singles, 12s. to 12s. 6d.

The fourth annual general meeting of the Bland Light Syndicate, Limited, was held last Tuesday, when a dividend at the rate of 20 per cent. per annum was declared; making, with the interim dividend paid for the six months ended Oct. 31, 1911, 15 per cent. for the year. The Manager (Mr. F. J. Gould) has now been appointed a Director of the Company.



THE "MAIN" STANDARD.

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Ashton-under-Lyne, &c., Water Board.

The new reservoir for the Ashton-under-Lyne, Stalybridge, Mossley, and Dukinfield Joint Water Board, at the summit of Chew Valley, is steadily approaching completion; and the work, which was commenced in the autumn of 1907, is expected to be out of hand during the coming autumn. The reservoir, which will have a capacity of 200 million gallons, is chiefly intended for compensation purposes, for streams which have already been impounded, and two mains are being laid from it, each over 2 miles in length—one to the Higher Swineshaw reservoir and the other to the Yeoman Hey reservoir. It will have a top-water area of about 50 acres; and the embankment across Chew Valley is 75 feet high, and about ¼ mile long. The drainage area dealt with under this scheme amounts to 1730 acres, of which 830 acres are above the site of the reservoir. The produce of the 900 acres below this point will be carried by a water course to the Yeoman Hey reservoir, as there are no suitable sites here for other reservoirs. The works include, in addition to the reservoir, about 6 miles of pipe line, varying from 24 to 9 inches diameter, 1¼ miles of aqueduct 3 ft. 6 in. diameter, a tunnel three-eighths of a mile long, five weirs, and other subsidiary works. The Contractors are Messrs. Morrison and Mason, of Glasgow; and Messrs. George H. Hill and Sons are the Engineers. The Resident Engineer is Mr. A. L. Mellor. The scheme is expected to involve an expenditure of £150,000. Two large filter stations in the Greenfield and Swineshaw Valley have just been finished by the Joint Board, at a cost of £25,000; and there is to be a civic opening on the 19th inst.

High Wycombe Gas Company.—At the meeting of this Company last Tuesday, the Directors reported an increase of 3 million cubic feet in the quantity of gas sold in the six months ended the 30th of June, compared with the sale in the first half of 1911. The profit was £1256, and with the addition of £2618 brought forward and £12 for bank interest there was a total of £3886. After paying interest on debentures and providing for the dividends on the preference shares, there was a balance of £3564, out of which the Directors recommended the payment of dividends at the rate of 10 and 7 per cent. per annum. This would leave a sum of £2647 to be carried forward.

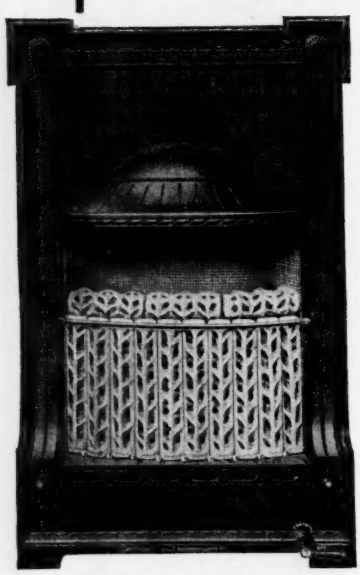
Gas Profits at Colwyn Bay.—At the last meeting of the Colwyn Bay Urban District Council, the annual report of the Gas Manager (Mr. J. Smith) was presented; and he was accorded the thanks and congratulations of the Council upon the progress made during the two years the works have been under his control. When he was appointed, the undertaking showed a loss; but during the year just closed, the profit amounted to between £2500 and £3000, or a net profit of £1630, to which there was to be added £1000 transferred to the capital account. Mr. Smith reported that he was in favour of a reduction of charges, and pointed out that the difference between cost and selling price showed a surplus of 5·98d. per 1000 cubic feet. This might, he said, be utilized with advantage in giving relief to consumers.

New Filters at Torquay.

The members of the Torquay Corporation paid their annual visit of inspection to the water-works on Dartmoor last Thursday. On this occasion particular attention was directed to the installation of Candy filters which has been made, with the object of eliminating any trace of vegetable impurity which the water may contain. There are twelve filters, arranged in two batteries of six each, one on each of the mains from the two sources of supply, and so disposed as to provide space in a centre gangway for all valves, fittings, and appliances for the manipulation of the filters. The steel cylinders, or filter shells, are fitted with an imperishable non-corroding granite lining, and special provision has been made for scouring the filtering material. In addition to gauges by which the condition and working of each cylinder can be ascertained at any time, an index-valve shows the speed of filtration, and a mercurial gauge indicates when the cylinders require cleaning. A small oil-engine provides the necessary power for the working of the air compressor and rotating the air and hydraulic scours. The present installation is capable of dealing with a supply of 2,225,000 gallons per day, and provision is made for extension should the demand for water exceed this quantity. Mr. S. C. Chapman (the Water Engineer) gave a description of the plant and its working, and expressed the opinion that it would serve the needs of Torquay for many years to come. At a luncheon held in connection with the visit, Alderman W. B. Smale (the Chairman of the Water Committee) said that during the past three years the profit from the undertaking had increased by £5000. Dr. G. M. Winter, the Deputy-Mayor, who described the water-works as one of the greatest assets the town possessed, said they had always been proud of the purity of the water, and the filtration would add to its reputation.

Storage Reservoirs for Thames Water.—Replying to Mr. Hennell's letter on this subject to "The Times," as noticed last week in the "JOURNAL" (p. 634), Mr. Walter Hunter says that he finds Mr. Hennell's original statement, that the Enborne Valley was surveyed is correct, and that a scheme was prepared for its utilization; and he expresses regret that any misapprehension should have arisen. He points out, however, that this does not affect his main argument. "Why," he asks, "was the Enborne chosen? Because Mr. Bryan [the Chief Engineer of the Metropolitan Water Board], having carefully examined the main and tributary valleys of the Thames, found that the Enborne possessed greater potentiality for water supply than any other valley, including that of the Loddon." He adds that the main point of his letter remains unaffected—viz., that, having considered the catchment area of the Thames with the view of constructing reservoirs upon the lines advocated by Mr. Hennell, Mr. Bryan arrived at the conclusion that an extension of the Staines reservoirs scheme was the best and most economical solution of the problem—a conclusion which, after due consideration, was adopted by the Metropolitan Water Board.

WRIGHT'S NEW BUILD-IN GAS GRATE MOVEMENT.



The "STANDARD."

It would be difficult to exaggerate the great departure in gas-heating ushered in by the introduction of these apparatus, and the wide possibilities they open up. Hitherto a Gas-Fire has been introduced into houses where coal fires were already built-in. The Great "Boom" in Gas-Fires which has now set in, has prepared the way for a new movement, namely, the building-in of the gas grates in newly-built houses, from the outset. Our new "Times" and "Standard" Gas Grates are expressly fitted, both in design and price, to render such a movement general, and those who are building houses can now instruct their architect to fit them throughout with built-in Gas Grates.

JOHN WRIGHT & CO.,
Essex Works,
BIRMINGHAM.

Increase in Price at Batley.

A recommendation of the Gas Committee that the net price of gas be increased from 2s. 4d. to 2s. 7d. per 1000 cubic feet from Oct. 1 led to a long discussion in the Batley Town Council last Thursday. The Chairman of the Gas Committee (Alderman Smith Ward) said that the increased charge was necessary in order to meet the higher cost of coal, which amounted to £2300. The Committee had already promised £4650 towards the relief of rates; but not a single penny of the extra 3d. per 1000 cubic feet of gas would go in that direction, as more than 3d. would be required to cover the enhanced price of coal. Mr. Sykes, in moving that the minute be referred back, said the great bulk of the gas was used by small consumers, and it was the poorer classes, therefore, who contributed most to the profits of the undertaking. On the other hand, 33 out of 56 mills in the borough did not use gas except as a stand-by in case the electricity generated at the mills should fail. The rateable value of these 33 mills was £17,373; and it was evident the owners would gain by the gas charges being raised and the rates kept at the present level. Mr. Turner remarked that he had been staggered to learn that the price of coal had been raised 2s. per ton. The extreme extra cost placed upon the coal trade by legislation in the last two or three years was 8d. per ton. Mr. North maintained that the amendment was a piece of cheap electioneering. The Council adopted, by fourteen votes to seven, the minutes of the Committee which contained the recommendation.

Belfast Gas Supply.—In moving the adoption by the Belfast County Borough Council of the minutes of the Gas Committee, Alderman Craig said they had accepted tenders for coal supplies during the coming year, and the average price would show an increase of some 2s. 5d. per ton, which represented a sum of £13,500. The Committee had been looking forward to making a reduction in the price of gas; but the increased cost of coal stood in the way. Automatic lighting has been applied to 200 street-lamps for the past twelve months, with satisfactory results; and an additional 500 lighters have been ordered.

Gas Company's Triumph at Norwich.—At the close of an article in last Saturday's "Norfolk News," giving an account of the steps taken by Mr. Thomas Glover and his staff to maintain the supply of gas to Norwich during the late disastrous floods, the following remarks were made: "In the flooded area the Gas Company have sustained considerable loss owing to the damage done to meters and gas installations; but prompt measures are being taken to deal with these matters, and also with the broken mains which resulted from subsidence in various parts of the district. The important part which the manufacture and distribution of gas takes as one of the public services is sometimes overlooked; but on this occasion, though an interruption in the supply has not occurred to emphasize its value, we are quite sure the citizens will appreciate the efforts made by the Company's staff to ensure a constant supply."

Educating Gas Consumers at Bolton.

Asked at last Wednesday's meeting of the Bolton Town Council what was meant by the appointment of a "special gas inspector," Alderman W. Webster, the Chairman of the Gas Committee, explained that an effort was being made to extend the use of gas within the supply area and also to impart information to consumers as to how to get the best results from the gas consumed, and likewise to give advice as to the use of gas for cooking, heating, and other purposes. A canvass was being made of the town, and several inspectors had been going round; but these men were not what they could call experts on the question of the utilization of gas. The new special inspector would be an expert, and would work under the direction of the Gas Engineer. Other towns had derived great benefit, and the gas departments an increased output, by the appointment of such an expert. In the course of the discussion, it was suggested that this was a move on the part of the Gas Committee to push the sale of gas at the expense of the Electricity Department. Alderman Haslam pointed out that, owing to the variation of pressure in different parts of the town, many people, from want of knowledge, were not using gas to the best advantage, because, chiefly, they had not the right burners. This meant a great deal to the consumers and to the department, because if all the lighting were carried out properly they would be able to reduce the candle power, instead of having to keep it so much higher than the standard of other towns. He was a member of the Gas Committee, and had never heard any suggestion of competition with the Electricity Committee. The minutes of the Committee were adopted.

Ottoman Gas Company, Limited.—In the report to be presented by the Directors of this Company at the ordinary general meeting next Tuesday, they state that the gas-rental for the six months ended June 30 amounted to £22,325, and for the corresponding half year of 1911 to £20,928; the net profit being £4362, compared with £4598. The amount standing at the credit of the profit and loss account is £9685; and the Directors recommend the payment of a dividend at the rate of 7 per cent. per annum on the preference shares (less income-tax), and 10 per cent. per annum on the ordinary shares (tax free), leaving a balance of £6191 to be carried forward.

North Shore (Sydney) Gas Company.—In the report for the six months to June 30, the Directors of the North Shore (Sydney) Gas Company state that, to meet the increasing demand for gas, arrangements have been made to duplicate the trunk main from the works, and larger branch mains are now being laid in various parts of the Company's district. It has been decided to instal a coke-handling plant in connection with the No. 3 retort-house; and the necessary machinery has been ordered. The balance to the credit of profit and loss account, including transfer from suspense account, and after allowing for bad debts, depreciation, reserves, &c., is £10,104. A dividend of 4 per cent. for the half year will absorb £7747, and a bonus of 1 per cent. £1936; leaving a sum of £421 to be carried forward.

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Additional Capital for the Weston-super-Mare Gas Company.—In accordance with the announcement which appeared in the advertisement columns of the "JOURNAL" for the 20th ult., Messrs. C. E. Masters and Co. (in conjunction with Messrs. Lalonde Bros. and Parham) offered for sale, by order of the Directors, £6000 of new 5 per cent. maximum ordinary stock of the Weston-super-Mare Gas Company. It was put up in £50 lots; and so great was the eagerness of buyers that the whole of the stock was disposed of in half-an-hour. The total amount realized was £6836, or about £114 per £100.

Price of Gas at Teignmouth.—At the meeting of the Teignmouth District Council last Tuesday, Mr. G. Denney, the Chairman of the Gas Committee, again referred to the question of the price of gas, and said he regretted the Council were not in favour of a reduction. Last year they took off 2d. per 1000 cubic feet; and in his opinion they could very well reduce the price by another 1d., which would make it 3s. per 1000 cubic feet. Mr. W. Turpin said the Gas Manager (Mr. J. A. Gray) did not recommend a reduction at present. If in the near future he should do so, the majority of the Council would no doubt willingly support it.

Brussels Gas Supply Last Year.—The revenue from the municipal gas supply of Brussels in the past year was 7,403,707 frs. (£296,148). After deduction of the general expenses, there was a profit of 2,438,429 frs. (£97,537), compared with 2,486,998 frs. (£99,480) before. The carbonization of 119,568 tons of coal produced 46,633,910 cubic metres, or rather more than 1646 million cubic feet of gas, of which 39,897,963 cubic metres, or 1408·4 million cubic feet, were sold. The quantity used for heating purposes was 7,127,968 cubic metres, or 251·6 million cubic feet; and that employed for cooking considerably increased. There were 47,146 meters in use at the close of the year, or 1004 more than at the corresponding period in 1910. In the past twelve months, 458 prepayment meters were put in, bringing up to 6689 the number of these meters in service; and 147 rising pipes for separate tenements were fixed, making the total number 7054.

Tipton Gas-Works Extensions.—At the meeting of the Tipton Urban District Council on Monday last week, the Gas Committee reported that the estimates of the Gas Engineer and Manager (Mr. Sidney O. Stephenson) for the proposed improvements and extensions of the gas-works amounted to £10,790; and they recommended that the following contracts should be accepted: Mr. G. E. Proberts, Bilston, £499, for the boiler-house; Messrs. R. & J. Dempster, Manchester, £440 for the scrubber and £235 for the engine and exhauster; and West's Gas Improvement Company, Manchester, £9700, for the vertical retorts. The Chairman of the Gas Committee (Mr. Robins) said their plant was now thirty years old, and was incapable of meeting the present requirements. The interest on the necessary loans would be 3⅛ per cent.; and he estimated that, after providing for the redemption of the loans and all the costs incurred in connection therewith, the new plant would represent a saving of about £600 a year. The report was adopted.

Stourport and its Water Supply.—The question of the water supply has been considered at a special meeting of the Stourport Urban District Council, as the contract for a supply from the Kidderminster Corporation, which has been in force for 33 years, will shortly expire. The Council asked for a reduction from the present charge of 6d. per 1000 gallons; but to this the Kidderminster Corporation were unable to agree. Consequently, the Council took steps to secure a report as to the advisability of obtaining water from the Bewdley Corporation. The price will be 5d. per 1000 gallons, and the contract for 33 years, with the option of renewal. This proposal commended itself to the Council, who decided to apply to the Local Government Board for sanction to borrow £1400 for the necessary outlay on new mains.

Ryde Gas Company.—At the recent annual general meeting of this Company, the Chairman (Mr. E. Groves, J.P.) submitted the annual accounts and the report of the Directors. The former showed a balance available for distribution of £6265, out of which the Directors recommended the payment of the full authorized dividend at the rate of £5 15s. per cent. The price of gas was reduced on July 1, 1911, from 3s. 1d. to 3s. per 1000 cubic feet. Plant for the manufacture of sulphate of ammonia had been installed, and was working most satisfactorily. Having a large supply of coal on the works, the miners' strike did not cause much expense or inconvenience. Contracts for coal had been made at a considerable increase. The report was unanimously adopted. The retiring Directors and Auditor, having been re-elected, the usual votes of thanks were given to the Directors, the Manager (Mr. F. F. Farrand), the Secretary (Mr. A. E. Coombes) and staff. The proprietors then inspected the sulphate of ammonia plant and some new workshops which have been erected.

Gainsborough Gas Undertaking.—According to particulars of the working of the gas undertaking of the Gainsborough Urban District Council in the past financial year which have lately been published, 7911 tons of coal were carbonized—an increase of 182 tons; and the gas made was 90,123,000 cubic feet, or 2,268,000 cubic feet more than before. There was an increased make of 26 cubic feet per ton of coal carbonized; the figure now reaching 11,392 cubic feet. The number of meters fixed is 3234, compared with 1211 when the Council purchased the works; the year's increase being 224. The number of cookers fixed is 1127, compared with 83 in 1900; the increase in the year being 102. During the period in which the town has owned the undertaking, the sum of £14,032 has been spent in extending the works and the distributing plant. Notwithstanding this, the indebtedness on the concern, which cost £86,769, was £84,794 on the 31st of March last. In the same period, out of the gross earnings a total sum of £52,784 has had to be earned and provided for the repayment of principal and interest. The past year's working shows the total income to have been £16,375; and after payment of £5315 for interest, instalments of loans, and sinking fund, £5087 for coal, £1640 for repairs and maintenance of works, and £976 in respect of mains and services, with other expenses, there was a balance of £102 on the year's working.

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Gas Poisoning while Clearing Tar-Blocked Pipes.—"Hæmorrhage on the brain due to inhaling gas," was the Jury's verdict on Friday in the case of George Edward Ward, an employee at the gas-works of the Middleton Corporation. It was stated that Ward was engaged in clearing pipes blocked with tar, and was found by two fellow workmen lying unconscious by one of the pipes. He was removed home and attended by two doctors, and found to be suffering from gas poisoning, which caused death the same day.

Stretford Gas Company.—The profit made by this Company in the past half year amounted to £5185. Adding to this £2621 brought from the previous account, there was a disposable balance of £7806. In their report, submitted and approved at the meeting of the Company last week, the Directors stated that they had deemed it prudent to write-down the investments to their present value, and had therefore applied £1460 to the purpose; thus reducing to £6436 the amount disposable. It was recommended that dividends should be declared at the rate of 10, 7½, 7, and 5 per cent. per annum on the various classes of shares. This would absorb £4910, and leave £1436 to be carried forward.

Reduction in Price at Radcliffe and Pilkington.—A reduction in the price of gas is announced by the Radcliffe and Pilkington Gas Company, to take effect from the end of the present quarter. The charges will then range from 2s. to 2s. 8d. per 1000 cubic feet—a reduction in the different sections of 1d. per 1000 cubic feet. Mr. James Braddock, the Manager and Secretary of the Company, in the official notice states that the price of gas to prepayment meter consumers will also be reduced. The following will be the scale of charges from the end of the present quarter: When the quarterly consumption is less than 250,000 cubic feet, 2s. 8d. net; 250,000 feet and under 500,000 cubic feet, 2s. 7d. net; 500,000 cubic feet and upwards, 2s. 6d. net; for gas-engine and certain trade purposes, 2s. 3d. net; for gas-engine and other trade purposes, large users, 2s. net. In each case the discount is one of 2d. per 1000 cubic feet on the gross.

Morley Water Charges.—At a meeting of the Morley Town Council last week, Mr. Brown moved that the Water Committee be instructed to consider the advisability or otherwise of advancing the price of water and of forming a reserve fund. His contention was that they should charge more than 6½d. per 1000 gallons, in view of the fact that there were so many departments of the Corporation that did not pay; and he thought they ought to try to form a reserve fund from the water revenue, so that they would not have to call on the ratepayers to make up any deficiency in the accounts of other departments. Their water charges, he said, were less than those of any of the neighbouring authorities, and they could afford to increase the price by 1d. per 1000 gallons without imposing a hardship on manufacturers. The Chairman of the Water Committee (Alderman C. Scarth), however, opposed the proposal, pointing out that they already had a reserve fund, and were making a profit out of the supply. The resolution was defeated by a large majority.

Silverton Water Supply.—An inquiry was held at Silverton last Wednesday, by Mr. R. G. Hetherington, a Local Government Board Inspector, with reference to an application by the Tiverton Rural District Council for sanction to a loan for the purpose of providing a supply of water for the parish. Mr. J. Follett Pugsley, the Clerk to the District Council, explained that difficulties had arisen owing to the insufficiency of the existing supply of water, and that as the parish was largely rural there was opposition from ratepayers outside the area of supply to the expenditure of a large sum of money from which they would not benefit. A scheme had been prepared, the cost of which was estimated at £700; but as in the drought of last year nearly all the springs dried up, Mr. Montague Luke, the Engineer, found it necessary to modify the plans, and the total outlay would probably be £950 or £1000.

Ticehurst Rural District Council and the Water-Works.—The water supplied in the area of the Rural District Council by the Ticehurst and District Water Company, and the proposal to supplement the supply by taking water from the Rother at Burwash, were discussed at the last regular fortnightly meeting of the Council. The Council went into Committee to receive a letter from the Solicitor to the Company offering to sell the water-works to the Council. The Clerk (Mr. J. C. Lane Andrews) suggested that a Committee should be appointed to meet the Solicitor; and this was agreed to. The Medical Officer of Health (Mr. Hugh Stott) pointed out that it would be to the advantage of the whole district if the Council could get a supply like the one under consideration into their own hands. The Chairman (Mr. F. J. Noakes) said it was a very big matter, and they could not go into it till the next meeting.

Falmouth Gas Company.—Major Mead presided at the annual meeting of this Company yesterday week, when a highly satisfactory report was presented by the Directors. The increase in the consumption of gas had been maintained, and large improvements and alterations made to the works and plant. An interim dividend of 5 per cent. had been paid and the Directors recommended a dividend of 6½ per cent. for the second half of the year. The Chairman said the profit amounted to £2215. The receipts compared well with those for the previous year; but the high price of coal, and the fact that all material and appliances used in the manufacture of gas had advanced in price, had caused a heavier expenditure than usual. The Directors were well satisfied with the position of the Company. He did not think there was one in the West of England which had made the amount of money the Falmouth Company had done in the past ten years. It had become necessary to build another holder, which would cost £4000. It would be erected at the back of the works; and in order to do this a further expenditure of £3000 would be necessary in alterations to the coal-stores and other premises. To meet this expenditure, the Directors would have to issue the remaining £5000 of 5 per cent. preference stock. The meeting gave the necessary authority for raising this amount, or such part of it as was required.

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WARRINGTON and LONDON.

Electric Light Failure at Newquay.—When the performance was about to commence at the Victoria Hall, Newquay, last Saturday week, the main wire of the electric light fused. This caused great delay, and it was midnight before the play terminated.

Preston Corporation Water Deficiency.—Special reference is made in the annual report just issued of the Preston Borough Provisional Auditors to the water-works accounts. The Water Committee, by the aid of increased charges, have reduced the deficiency on the year's working; but their anticipations of being able to get their account somewhere near the paying basis have not been realized. There was a deficiency on the past financial year's working of £2845, compared with £4208 in the preceding twelve months; and the total deficiency now stands at £27,017. The income amounted to £34,521, as against £33,387 for last year, while the expenditure was £10,052, compared with £10,382. A sum of £9607 was added to the sinking fund, and interest and commission amounted to £17,706. The expenditure on capital account during the twelve months was £2351, chiefly on the enlargement of the Spade Mill reservoir. Further increases in charges have been put into force recently.

Electricity Charges at Brighton.—At the meeting of the Brighton Town Council last Thursday, Mr. Galpin drew attention to a letter he had sent to the General Purposes Committee regarding the reduction in the price of electricity from 4d. to 3d. per unit to consumers of 15,000 units per annum. The Committee had replied that such a reduction was only applicable to shops. Speaking in support of his letter, Mr. Galpin said the library electricity account was £405, and on this there could be made a saving of £100; the Town Hall electricity account was £340, and there again a saving could be effected if the concession were made. It seemed to him that the Council were bolstering up a big electricity concern by taking money out of the ratepayers' pockets. Why should not the Corporation undertakings have the benefit of a concession of rates? Mr. Campbell, the Chairman of the Lighting Committee, explained that the concession was made to a few large consumers, and it could not be granted to small ones.

Unusually Short Loan for Gas-Works Purchase —At the meeting of the Harrington Urban District Council last Wednesday, Mr. R. Millican in the chair, a letter was read from the Local Government Board regarding the loan for the purchase of the Harrington Gas-Works. The Board agreed to lend the money to the Council for four years only, instead of thirty years. The Chairman said he thought it was absolutely necessary to ask the Board to extend to thirty years the time to pay back the loan. It grieved him to think they were in this plight; but they could not draw back now as they had already agreed to purchase the gas works. A four-years loan would mean a repayment of £600 a year. The Clerk (Mr. W. White) stated that he had interviewed Mr. Grant, the Member of Parliament for the Division, on the subject, and he had sent to the Board a message to the effect that there had apparently been some misunderstanding. Mr. Plenderleath thought it a scandalous shame the Council should be so crippled.

The Gas Supply of Bognor.—The full statutory dividends have been declared by the Bognor Gas Company for the past half year; and at the meeting the Chairman (Mr. H. J. Lovett, J.P.) said that, in spite of the shortage of coal owing to the strike, the Company obtained their supplies without inconvenience or expense—the cost to them being no more than £5 or £6 extra. The new works had been so far completed as to allow of the manufacture of gas; and the present works in Argyle Road would be used for the electric light station—the Company having, in spite of strong opposition, secured powers to supply electricity. The increase in the number of gas consumers had been satisfactory, and things in general now looked very rosy. At an extraordinary general meeting, the Directors were authorized to issue a further £10,000 of capital; it being pointed out that this amount had nothing to do with the electric lighting scheme, a meeting in connection with which would be held in due time.

At a meeting of the Malvern Urban District Council last Tuesday, it was decided that the Gas and Electrical Engineer (Mr. W. J. Rendell Baker) should advise and report as to the cost, &c., of erecting another gasholder at the Malvern Link Gas-Works.

A man seventy years of age committed suicide at Aston last week, by inhaling gas from a rubber tube connected with a gas-fitting. The widow stated that her husband had latterly been strange in his manner; but he had never threatened to take his life.

Recent issues of the "JOURNAL" have furnished examples of public lamps being selected by birds for building their nests. The current number of the "Co-Partners' Magazine" of the Gaslight and Coke Company contains a photograph showing a sparrow's nest which was recently found in the flue from a cooking-stove in one of the districts attached to the Camden Road office. A fitter was sent to attend to a complaint of a defective stove, and he found that the oven burners kept smothering without any apparent reason. Upon disconnecting the flue, he discovered the nest. The flue had four elbows in it and a cowl outside; but the nest was found in the second elbow from the stove inside the house.

The half-yearly conference of representatives of the Richmond Gas Stove and Meter Company, Limited, has just been held at Warrington—Mr. H. M. Thornton presiding. Special interest was centred in the important developments made in the works since the last conference, especially in the laboratories and research department. Great activity was being displayed in every section of the works; and the representatives were shown, and expressed satisfaction at, the complete arrangements made for coping with the orders anticipated and already coming in for gas-fires this winter. The firm's "A B C" series of gas-fires were carefully examined; and the representatives were impressed with the improvements which had been effected. The conference concluded by the Directors entertaining the representatives at dinner, and a social evening followed.

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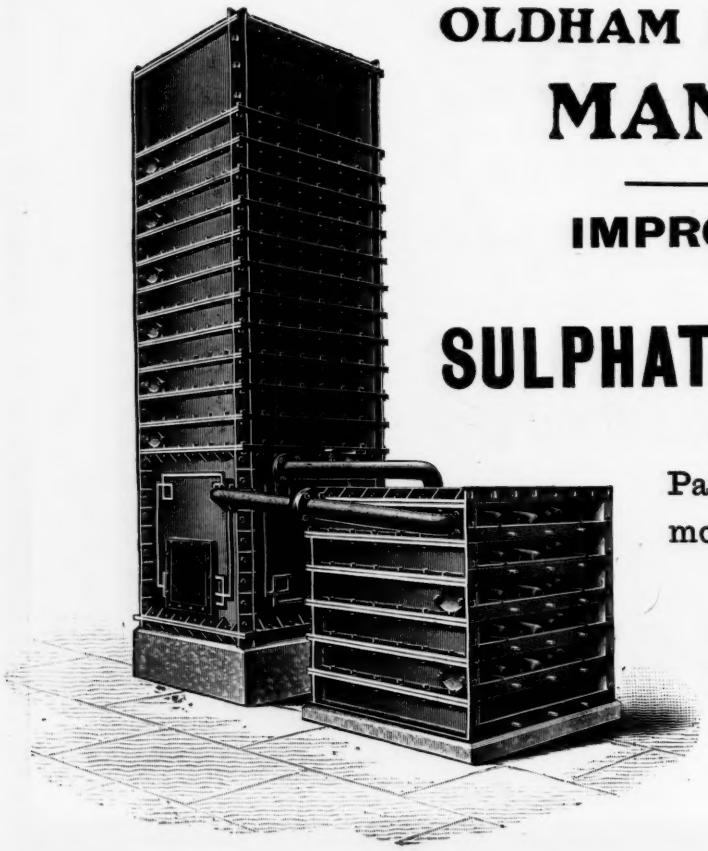

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WRITE FOR PARTICULARS.

The Hyde Corporation are applying to the Local Government Board for sanction to borrow £3000 in connection with the Gee Cross and Newton water scheme, which has just been completed at a cost of £14,000. The amount to be borrowed is the difference between the estimated and the actual cost of the scheme.

A successful exhibition of gas fires, cookers, and general gas apparatus has just been held at Eyam, under the auspices of the Hathersage and District Gas Company, by the Richmond Gas Stove and Meter Company, Limited. Cookery lectures were given twice daily by Mrs. M. Dunn. Great interest was evinced by large audiences, and a considerable number of orders were placed.

Meldrums, Limited, has been registered with a capital of £20,000, in £1 shares, to carry on the business of manufacturers of furnaces, mechanical stokers, refuse destructors, &c., and to take over the freehold hereditaments and premises known as the Engineering Works, Timperley, Cheshire, and the business of an engineer formerly carried on by T. Gregory, as Liquidator, for and on behalf of Meldrum Bros., Limited, and recently by J. W. Meldrum.

Through the failure of the electricity supply last Friday night, the business part of the borough of Eccles was placed in darkness from eight until half-past ten o'clock. Shopkeepers had to conduct business as best they could by candle light or oil-lamps; one picture palace had to close; and at the Town Hall, where Mr. Victor Grayson was addressing a meeting, the platform and Chairman's table were outlined by the feeble glimmer from lamps and candles.

Last Wednesday morning, in the municipal electric light and power station at Maidenhead, adjacent to the Great Western Railway, a 6-ton fly-wheel of a Diesel engine broke and wrecked the large engine-room. The engine was destroyed, and much damage was done to the other machinery in the station. In the local works which use electric power, the current for lighting was completely cut off; and it was feared that the town would be in darkness at night. The service was partially restored, however, by the use of duplicate plant.

APPLICATIONS FOR LETTERS PATENT.

19,490.—M'Court, C. D., and Radiant-Heating, Ltd., "Combustion of gaseous fuels." Aug. 26.

19,495.—Crone, F. G., "Radiating and mixing units for fluids and gases." Aug. 26.

19,515.—Hendunen, A., and Simonenko, A., "Producing gas." Aug. 26.

19,611.—Read, W. G., "Transfer by conveyors of material stored in bulk." Aug. 27.

19,621.—Mollett, J. N., and Edwards, E. E., "Shade supports." Aug. 28.

19,635.—Farnham, R. V., "Gas-producers." Aug. 28.

19,668.—Lang, A., "Preparation to clean, renovate, and strengthen gas-mantles." Aug. 28.

19,678.—Clerk, D., "Internal-combustion motors." Aug. 28.

19,722.—Preston, J., "Gas-globes." Aug. 29.

19,736.—Bruno, W., "Demonstrating the strength as regards flexibility of incandescent gas mantles after they have been burnt-off." Aug. 29.

19,796.—Eliot, E. G., "Collecting carbonic-acid gas." Aug. 30.

19,800.—Tomey, E. T., "Valves for gas-furnaces." Aug. 30.

19,812.—Lengersdorff, N., "Heating regenerative chamber furnaces." Aug. 30.

19,838.—Granjon, P. J., "Purifying gases." Aug. 30.

19,841.—Osthoff, W., "Producing gas mixture." Aug. 30.

19,845.—Ehrich and Graetz, "Regulating burner nozzles." Aug. 30.

19,853.—Tooth, L. F., "Regenerative burners." Aug. 30.

19,881.—Crosbie, S., "Oil-gas producers." Aug. 31.

19,903.—Fletcher, Russell, and Co., Ltd., and Fletcher, T. W., "Gas or coal fire stoves." Aug. 31.

19,909.—M'Court, C. D., and Radiant-Heating, Ltd., "Combustion of liquid fuel." Aug. 31.

GAS COMPANIES' STOCK AND SHARE LIST.

If we exclude from consideration (though with all respect) the more speculative markets, in which there was always a pretty constant flutter going on, the week just completed on the Stock Exchange was a thoroughly disappointing one. Business was dull and slack; and a tone of depression was the characteristic in all departments. And there was no very discernible reason why this flatness should be. With money in abundance, one might have looked for some degree of elasticity in the gilt-edged category; but they had not the least spring in them. Railways could contemplate favourable traffic returns and a fair promise of a period free from labour conflict, and yet find no comfort. The opening day was not bad—preserving one or two bright rays from the previous Saturday. Government issues were steady; and Rails, after some hesitation, were fairly active and cheerful. But Tuesday was dull and heavy—pulled down by realizations, which reduced prices all round in leading stocks. Wednesday opened in the same mood. Government issues were flat, and Consols lost another ¼. Rails, after their full share of the depression, took heart and recovered some ground. Business on Thursday was very quiet; and the tone generally was dull with dwindling prices. Friday had very poor business with an irregular tendency. Gilt-edged things were mostly weak, Consols were ⅛ lower, and Rails met with no support. Americans were about the strongest market. Saturday was quite quiet, and movements were slight; but, such as they were, they were mostly in the downward direction. Consols were unchanged; closing at 74¼ to 74½ *ex div.* In the Money Market, there was an abundant supply. Short loans were very easy; and discount rates, after a bit of a stand, gave way. Business in the Gas Market was still upon the holiday scale of inactivity, though certainly not down to the semi-stagnation point of the previous week. Everything dealt in was very firm; and the two or three changes effected in quotations were in favour of higher prices. In Gaslight and Coke issues, the ordinary was strong and steady, though unavoidably inactive; and transactions ruled from 105¾ to 106½. In the secured issues, the maximum realized from 82¼ to 83½, the preference 99½ and 100, and the debenture from 76 to 77. South Metropolitan was fairly active, and changed hands at 116½ to 118. The debenture marked 77. In Commercials, the 4 per cent. was done at 105¾ to 107, the 3½ per cent. at 101 and 102, and the debenture at 73½ and 73¼. Among the Suburban and Provincial group, Alliance and Dublin and Brentford new advanced 2 each. Dealings were marked in British at 45½, Brentford old at 258 and 258¼, ditto new at 197 and 197½, ditto debenture at 96¾, Lea Bridge at 125, South Suburban at 120 and 120½, and ditto debenture at 121 and 121¾. On the local Exchange, Newcastle marked 98¾. Among the Continental companies, Imperial showed transactions at 180½ to 183, Union at 84½ and 85½, and European at 19⅞ to 19¾. Among the undertakings of the remoter world, Hong-Kong realized 16 37/64 and 16⅝, Monte Video 11¼, Primitiva from 7 9/16 to 7 11/16, ditto preference from 5¼ to 5 7/16, ditto debenture 96¾, and San Paulo preference 12⅛.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Apl. 12	5	Alliance & Dublin Ord.	75—80	+2	6 5 0
374,000	Stk.	July 12	4	Do. 4 p.c. Deb.	89—91	..	4 7 11
250,000	5	Apl. 12	7½	Bombay, Ltd.	6—6½	..	5 15 5
50,000	10	Aug. 29	15	Bourne- mouth Gas & Water	10 p.c.	..	5 3 5
332,000	10	"	7		B 7 p.c.	..	4 6 2
75,000	10	"	6		Pref. 6 p.c.	..	4 2 9
380,000	Stk.	Aug. 14	13½	Brentford Consolidated	255—260	..	5 3 10
330,000	"	"	10½	Do. New	195—200	+2	5 5 0
50,000	"	"	5	Do. 5 p.c. Pref.	116—118	..	4 4 9
206,250	"	June 14	4	Do. 4 p.c. Deb.	95—97	..	4 2 6
218,230	Stk.	Aug. 29	11	Brighton & Hove Orig.	210—215*	..	5 2 4
244,200	"	"	8	Do. A Ord. Stk.	152—155*	..	5 3 3
530,000	20	Mar. 28	12½	British	44½—45½	..	5 9 11
120,000	Stk.	June 28	4	Do. 4 p.c. Deb. Stk.	91—93	..	4 6 0
250,000	Stk.	June 28	4	Buenos Ayres 4 p.c. Deb.	93—95	..	4 4 3
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	3½—4½	..	—
100,000	Stk.	June 28	4½	Do. 4½ p.c. Deb. Stk.	74—76	..	5 15 5
157,150	Stk.	Aug. 29	5	Chester 5 p.c. Ord.	107½—109½*	..	4 11 4
1,513,280	Stk.	Aug. 29	5/9/4	Commercial 4 p.c. Stk.	105—107*	..	5 2 1
560,000	"	"	5½	Do. 3½ p.c. do.	100—102*	..	5 4 5
475,000	"	June 14	3	Do. 3 p.c. Deb. Stk.	73—75	..	4 0 0
800,000	Stk.	May 31	4	Continental Union, Ltd.	83—86	..	4 13 0
200,000	"	"	7	Do. 7 p.c. Pref.	133—135	..	5 3 8
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	"	—	4	Do. Deb. Stk.	103—105	..	3 16 2
1,002,180	10	July 26	10	European, Ltd.	19—20	..	5 0 0
16,160,600	Stk.	Aug. 14	4/17/4	Gas-light and Coke	4 p.c. Ord.	..	4 11 0
2,600,000	"	"	3½		3½ p.c. max.	..	4 3 4
4,062,235	"	"	4		4 p.c. Con. Pref.	..	4 0 0
4,531,705	"	June 14	3		3 p.c. Con. Deb.	..	3 17 11
258,740	Stk.	Mar. 14	5	Hastings & St. L. 3½ p.c.		..	5 5 3
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Apl. 26	11	Hongkong & China, Ltd.	16½—17	..	6 9 5
131,000	Stk.	Mar. 14	7⅞†	Ilford A and C	157—160	..	4 18 9
65,780	"	"	6½†	Do. B	123—125	..	4 16 0
66,500	"	June 28	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
4,940,060	Stk.	May 15	9	Imperial Continental	178—183	..	4 18 4
1,235,000	Stk.	Aug. 14	3½	Do. 3½ p.c. Deb. Red.	86—88	..	3 19 7
200,242	Stk.	Aug. 29	6	Lea Bridge Ord. 5 p.c.	122—125*	..	4 16 0
561,000	Stk.	Aug. 29	10	Liverpool United A.	211—213*	..	4 13 11
718,100	"	"	7	Do. B.	152½—154½*	..	4 10 7
306,083	"	June 28	4	Do. Deb. Stk.	100—102	..	3 18 5
63,180	Stk.	June 28	3	Maidstone 3 p.c. Deb.	66—68	..	4 8 3
75,000	5	June 14	6	Malta & Mediterranean	4⅜—4⅝	..	6 3 1
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	—	..	—
250,000	100	"	4½	Melbourne 4½ p.c. Deb.	101—103	..	4 7 5
541,920	20	May 31	3½	Monte Video, Ltd.	11—11½	..	6 1 9
1,775,892	Stk.	July 26	4½	Newc'tle&G'tesh'd Con.	98½—99	..	4 8 5
529,705	Stk.	June 28	3½	Do. 3½ p.c. Deb.	84⅝—85⅛	—¼	4 2 1
55,940	10	Aug. 29	7/7/0	North Middlesex 7 p.c.	13½—14½*	..	5 1 4
300,000	Stk.	May 15	8	Oriental, Ltd.	134—136	..	5 17 8
60,000	5	Mar. 14	10†	Ottoman, Ltd.	8¼—8⅜	..	5 14 3
60,000	50	Aug. 14	13	Portsea Island B	127—130	..	5 0 0
100,000	50	"	12	Do. C	124—127	..	4 14 6
398,490	5	May 15	8	Primitiva Ord.	7⅛—7⅜	..	5 8 6
796,980	5	June 28	5	Do. 5 p.c. Pref.	5¼—5½	..	4 10 11
488,900	100	June 1	4	Do. 4 p.c. Deb.	96—98	..	4 1 8
312,650	Stk.	June 28	4	River Plate 4 p.c. Deb.	93—95	..	4 4 3
275,000	5	Apl. 12	12	San Paulo, Ltd.	13½—14½	..	4 2 9
150,000	10	"	6	Do. 6 p.c. Pref.	11¾—12¼	..	4 18 0
125,000	50	July 1	5	Do. 5 p.c. Deb.	49—51	..	4 18 0
135,000	Stk.	Aug. 29	10	Sheffield A	229—231*	..	4 6 7
209,984	"	"	10	Do. B	229—230*	..	4 6 11
523,500	"	"	10	Do. C	228—230*	..	4 6 11
90,000	10	May 31	7½	South African	8—9	..	8 6 8
6,429,895	Stk.	Aug. 29	5/9/4	South Met., 4 p.c. Ord.	116—118*	..	4 12 8
1,895,445	"	July 12	3	Do. 3 p.c. Deb.	76—79	..	3 15 11
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	155—157	..	5 8 3
605,000	Stk.	Aug. 14	5/16/8	S'th Suburb'n Ord. 5 p.c.	119—121	..	4 16 3
60,000	"	"	5	Do. 5 p.c. Pref.	116—118	..	4 4 9
117,058	"	July 12	5	Do. 5 p.c. Deb. Stk.	120—122	..	4 2 0
502,310	Stk.	May 15	5	Southampton Ord.	105—107	..	4 13 6
120,000	Stk.	Aug. 14	7½	Tottenham and A 5 p.c.		..	5 0 0
483,940	"	"	5⅝		B 3½ p.c.	..	4 19 2
149,470	"	June 28	4	Edmonton 4 p.c. Deb.		..	4 3 4
182,380	10	June 15	5	Tuscan, Ltd.	94—96	..	5 15 11
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	8⅜—8⅝	..	5 1 0
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	97—99	..	4 9 3
255,636	Stk.	Aug. 29	6⅞	Wands- worth B 3½ p.c.		..	4 17 6
85,766	"	June 28	3		3 p.c. Deb. Stk.	..	4 3 4

Prices Marked * are "Ex. Div." † Next dividend will be at this rate.

A Company under the title of Messrs. W. G. Field and Co. has been registered with a capital of £15,000, in £1 shares (5000 preference), to carry on the business of manufacturers of gas fittings and appliances.

In the course of an interview recently with a correspondent of the "Arbroath Herald," Mr. James Keith, of James Keith and Blackman Company, Limited, whose pamphlet on "Industrial Unrest" has been noticed in the "JOURNAL," stated that, though he had been in business for more than 42 years, employing a large number of skilled men, he could truly say that he had never had a strike nor any serious dispute with his employees. When it is remembered that Mr. Keith's firm employs many hundreds of skilled mechanics, both in London and Arbroath, the statement is alike remarkable and gratifying.

The Birkenhead Corporation Gas Committee have purchased premises in Argyle Street, and will utilize them as show-rooms for displaying gas heating and cooking appliances, and for giving demonstrations in lighting and cookery. This development will involve the closing of the present offices in Grange Road.

As already reported in the "JOURNAL," the Guildford Gas Company have secured a contract for lighting the principal thoroughfares of the town by high-pressure lamps for the period of ten years. It has been decided to lay Mannesmann steel tubes, jointed with lead wool, on either side of the streets; and all the work will be subjected to a test pressure of 20 lbs. to the square inch, by means of an air compressor, as the laying proceeds. Messrs. A. H. Ball and Co., Limited. of Farnham, have been entrusted with carrying out the scheme.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

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MAINTENANCE SUPERINTENDENT. No. 5625.

Appointments, &c., Wanted.

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POSITION BY SWISS GAS ENGINEER. Rudolf Mosse, Zurich.

Plant, &c. (Second-Hand), Wanted.

COKE-BREAKER. Wokingham Gas-Works.

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LAMP COLUMNS AND LANTERNS. Barnsley Gas Company.
SCRUBBER-WASHER, &c. Redditch Gas-Works.
STATION METER AND GOVERNOR. Llandudno Gas Department.

Meeting.

BRITISH GASLIGHT COMPANY. London Office. Wednesday, Sept. 25. Twelve o'clock.

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